SCIENTIFIC AMERICAN SUPPLEMENT. No. 1267

Copyright, 1900, by Munn & Co.

Scientific American, established 1845.
Scientific American Supplement, Vol. XLIX, No. 1267. NEW YORK, APRIL 14, 1900. Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

BURNING OF THE THÉATRE FRANÇAIS AT PARIS—THE STATUE OF VOLTAIRE PROTECTED BY A MATTRESS.

THE BURNING OF THE THÉATRE FRANÇAIS.

IN the burning of the Théâtre Français at Paris, on March 8, the world has lost one of her most historic playhouses, and the loss is particularly to be regretted, owing to the fact that many who will visit Paris for the first time on account of the Exposition will be prevented from seeing the theatre and its famous collection of bric-a-brac. The Comédie Française or Théâtre Français was not, as its name would imply, devoted exclusively to comedy. The word "comedie" was used in France in the early days of its stage to denote any kind of theatrical entertainment. The constitution of the Comédie Française dates from 1680, when, by order of Louis XIV., a company of the Hôtel de Bourgogne was united to that of the Théâtre Guénégaud in the Rue Mazarin. Although the Comédie Française cannot well be separated from the names of Corneille and Molière, they both died before the theatre was officially constituted. The history of the Comédie Française is a most interesting one, and as the King was always at its back, it is little wonder that it enjoyed virtual monopoly. Under the Revolution the playhouse assumed the title of "Théâtre de la Nation," and on the eve of the Reign of Terror, the players were formally obliged to replace such words as "seigneur" and "monsieur" with "citoyen," even when the piece was written in verse, so that the heroes of the Iliad and the history of Rome were "citoyen;" which, apart from the intrinsic absurdity of the thing, could not but spoil the meter. One effect of the Revolution was to deprive the Comédie Française of the privilege it had so long and so unjustly enjoyed, of incorporating in its company any actor or actress whom it might choose to detach from some other troop, not only in Paris, but in any other part of France.

In 1802 the Comédie Française received a special subsidy of a hundred thousand francs, and in 1803, in conformity with an order from the First Consul, it took possession of the building in the Rue Richelieu, close to the Palais Royal, where it has ever since remained. The interest of the theater is one of association only. It has no pretension to splendor, but it has a history which leaves that of the Opera far behind. The present building is a comparatively new one, but it is a museum of old treasures; no other theater in the world is so rich in works of art. In the green-room, in the committee room, in the office of the administrators, in the archives, and every part of the theater to which the public has no access, there is a prodigious mass of full-length portraits, of medallions, of genre pictures, of engravings, drawings, marbles, bronzes, statuettes, etc., which, with the statues and busts exhibited in the public rooms and in the vestibule, formed a unique collection whereof every piece belonged in some way to the history of the house of Molière. The museum of properties is as rich in its way as the museum of painting and statuary. Thus, for example, we may find the mandolin used in the "Barber of Seville," and the original guitar of the "Marriage of Figaro." When the latter piece came out in 1784, the management thought it was so sure to fail that it was not worth while to buy a guitar for the rôle, so the instrument was hired at ten francs a night. The piece ran for fifty nights, and the conditions on which the guitar had been obtained were forgotten until the owner presented his bill for 500 francs. The canes and walking sticks are just as curious in their way, and among other curiosities there are two bells. One of them is said to be the very one which gave the signal for the massacre of St. Bartholomew, at any rate we know that the bell was taken down from the church at the time of the Revolution to be melted up for cannon. Another priceless possession of the house was the armchair in which Molière played the part of Argan in his own piece, "Le Malade Imaginaire," and in which he suffered the first shock of the illness which was destined to carry him off after the fourth representation. Let us hope that this was not burned in the fire. As for the archives and the library, there is certainly nothing like them in the theatrical world. In 1880 the Comédie Française celebrated the second centenary of its foundation.

On March 8, at five minutes of 12 (noon), an alarm of fire was given by the stage carpenters, who were setting the scene for the matinee of "Bajazet." A thick column of smoke soon filled the house, the panic of the staff and the company was great, but they all succeeded in escaping with the exception of Mlle. Jane Henriot, who was asphyxiated. A member of the staff of our BUILDING EDITION was in Paris at the time, so we are able to present some of the scenes of an eye-witness. That the fire was no worse than it was reflects great credit upon the original builders. The fire department accomplished something, but did not appear to good advantage; it was 15 to 20 minutes before more than one engine arrived, and the water pressure was insufficient, still none thought of stopping the fountains. The firemen seemed to be all chiefs, they were intensely nervous, and finally lost their heads entirely. Almost priceless paintings were thrown out of windows, and clocks of small value were carefully lowered down with ropes. The management of the Théâtre finally arrived, and brought them up with a round turn, and then the bric-a-brac was protected in various ways, as in the case of the statue of Voltaire shown in our engraving, for which we are indebted to L'Illustration. The loss, coming as it did within five weeks of the opening of the Exposition, is irreparable. The company will play elsewhere, but it was hoped that the profits this season would recoup former losses. Half the show to the stranger was the house, which will have to be rebuilt. A Paris contractor offered to rebuild it, using American methods, in the short space of sixty days; but his offer was rejected on the ground that as the edifice belongs to the state, its construction must remain in the hands of state officials, so that while it will be well rebuilt, there is no prospect of seeing its speedy completion.

THE FUTURE WHEAT PROBLEM.

STARTING with the premise that Sir William Crookes is to be believed, The London Spectator observes that scarcity of food is not by any means remote; it may come within sight of persons now alive, and these not very young. The case may be very easily stated. At present the deficiencies of the wheat-eating countries are supplied by North America, especially by the United States. In 1897-98 the wheat crop of the United States was about 540,000,000 bushels. Of this quantity 217,000,000 bushels were exported to Europe, where no country, excepting Russia and Turkey, grows enough for its own population. The States are able to do this without trenching on the home supply because the total population is not more than 75,000,000. In 1931, if the increase of population goes on at the same rate as that of the last thirty years, the 75,000,000 will have increased to 130,000,000, and the surplus for export will be no longer available. Whence, therefore, will the wants of the world be supplied? Russia at present exports largely, the total being something more than two-fifths of that from the States. But it cannot be hoped that Russia will come to the rescue of a hungry world. It is already hungry itself, exporting food while its own people are starving. Any change here must be in the way of distribution. This change will be the more speedy because the Russian population, in spite of its sufferings, increases. Indeed, the difficulty of the general problem is aggravated by the fact that up to the point of actual starvation, scarcity not only does not check, but actually stimulates, the rate of increase. A perfectly well-fed, well-educated and generally comfortable population has a tendency to diminish rather than to grow.

THE FACILITIES AFFORDED BY THE OFFICE OF STANDARD WEIGHTS AND MEASURES FOR THE VERIFICATION OF ELECTRICAL STANDARDS AND ELECTRICAL MEASURING APPARATUS.

THE need of adequate facilities for the official verification of standards and measuring apparatus of all kinds has long been recognized by American physicists. The Office of Weights and Measures, with its small force, modest equipment and insufficient appropriations, has endeavored to meet any demands imposed upon it within the limits thus set.

The object of this article is to describe what has thus far been accomplished along electrical lines, and in this connection a brief history of the units of reference may not be considered out of place.

The origin of standards of quantity and value dates back as far as the earliest historical records. The transition from the crude measures of antiquity to the systems meeting present requirements has, however, been exceedingly slow, although the growth of commercial intercourse gradually led to the introduction of more precise standards.

The requirements of accuracy were, nevertheless, quite modest until physics began to emerge from its qualitative stage to assume the dignity of an exact science.

The number and complexity of physical quantities at first led to the adoption of more or less arbitrary standards of reference, often based on the physical properties of some definite substance, e. g., the calorie, and as long as the relations between physical quantities remained obscure, such relative standards sufficed. With the development of the science came the recognition of the desirability of a consistent system of units, which was strongly brought to the front when it became necessary to measure magnetic quantities.

The happy solution of this problem suggested by Gauss, and extended to the measurement of electrical and electro-magnetic quantities by Weber, constituted a great advance in the science of metrology, the units being defined in terms of the mechanical actions to which they give rise. Since all mechanical units can be expressed in terms of three independent fundamental units, such as those of length, mass and time, the magnetic and electrical units of Gauss and Weber are thus expressible in terms of the same fundamental units and are, therefore, entirely independent of the physical properties of arbitrarily chosen substances. Hence, they are called absolute units, their magnitudes depending solely on the choice of the fundamental units.

The units of length and mass selected were usually multiples or sub-multiples of the corresponding metric units, the metric system being the only one meeting the highest scientific and practical requirements and being already in extensive use. While at first uniformity in the selection of the magnitudes of the fundamental units was lacking, the centimeter, gramme and second have now been universally adopted, the derived units being known as C. G. S. units.

Practical measurements of electrical resistance were, however, first referred to a variety of arbitrary standards, e. g., the resistance of a given length of copper or iron wire of given diameter; and so long as electrical measurements were confined to the laboratory, the length referred to was usually a few feet, but with the practical applications of electricity to telegraphy and submarine signaling, this length became inconveniently small and was, therefore, replaced by fathoms, miles, etc. Fortunately none of these units ever gained general acceptance. In 1848, Jacobi pointed out that it would be far preferable to adopt, as a universal standard, the resistance of a certain piece of wire, copies having the same resistance being easily constructed.

Jacobi carried this suggestion into practice by sending a piece of copper wire, since known as "Jacobi's Etalon," to various physicists for that purpose.

In 1860, Werner von Siemens proposed as a standard of resistance, the resistance, at 0° C., of a column of mercury, 1 square millimeter in cross section and 100 centimeters in length.

In 1861, a committee, composed of the most eminent English physicists, was appointed by the British Association to consider the question of Standards of Electrical Resistance. Correspondence was opened with the leading foreign physicists and various special investigations of the problems with which the committee was confronted, were undertaken by its members.

The first question settled was that the unit of resistance should be defined as a multiple by an integral power of 10 of the unit of Weber's absolute system, and that the unit chosen should be of a convenient magnitude. Accordingly, a unit equivalent to 10° C. G. S. units was adopted.

This definition fixed the unit, but the evaluation of a resistance in absolute measure requires the construction of especially designed apparatus, having usually a limited range of usefulness; the determination of instrumental constants, most frequently involving tedious mathematical approximations, and in addition, the observations have to be made with the greatest precision. On the other hand, relative measurements require simpler apparatus and less skill in manipulation, besides being, in most cases, far more accurate than absolute measurements. The construction of material standards adjusted to the specified resistance, determined once for all by a series of absolute measurements, was therefore decided upon.

Investigations were made to determine whether the absolute unit of resistance could be accurately defined in terms of the resistance of a definite portion of a definite substance. Pure metals in the solid and liquid state and alloys were studied with this end in view. On account of the excessive influence on the resistance produced by small quantities of impurities in metals and by small variations in the composition of alloys and on account of the additional difficulty of procuring chemically pure materials, the choice was greatly limited. Moreover, solids had to be rejected on account of the marked effect of physical changes produced by drawing, bending, annealing, etc.

Mercury, already recommended by Siemens, was therefore the only material to be further considered. Even this material was rejected, owing to large differences found to exist between coils, supposedly adjusted to agree with different German mercury standards, and the mercury standards constructed by members of the committee.

Having abandoned the above propositions, the alternative remained of constructing material standards adjusted with reference to the absolute unit.

A number of new alloys, in addition to many already in use, were made and investigated. An alloy of 2 parts by weight of silver to 1 part by weight of platinum was finally selected as best meeting all requirements. A special form of resistance standard was also adopted.

In 1863 and 1864 the values of certain coils were determined in absolute units by one of the methods proposed by Weber, and from these measurements the B. A. unit was derived. A number of copies were issued gratis by the association and in addition arrangements were made to furnish others at a moderate price. The B. A. unit soon gained universal acceptance in the English-speaking countries, while the Siemens unit still retained its supremacy on the Continent.

In 1878 it was shown by Professor Rowland that the B. A. unit differed from its assumed value by more than one per cent., and soon after, this difference was substantiated by a number of other investigators.

In 1881 a call was issued, in connection with the first Paris electrical exhibition, for an international electrical congress for the purpose of adopting definitions of the electrical units to serve as a basis for legislative enactments. Numerous mercury standards had in the meantime been constructed and had been found to agree most satisfactorily with one another; moreover, the results of a considerable proportion of the absolute determinations made had been referred, directly or indirectly, to the Siemens unit. In view of this, the Paris Congress passed a resolution recommending that all absolute determinations in the future be expressed as the resistance of a column of mercury of stated length, 1 square millimeter in cross section at the temperature of melting ice, and that the C. G. S. electromagnetic system of units be adopted. The desirability of making new determinations of the ohm was urged.

Three years later the Congress reassembled at Paris and adopted 106 centimeters as the length of the specified column of mercury, individual results still differing by as much as ± 0·5 per cent. The unit of resistance thus defined was called the legal ohm, but while it was never legalized anywhere, it nevertheless came into extensive use, especially in England and in America.

Absolute methods were gradually improved, sources of error were pointed out, and eliminated as far as possible, and accordingly the results of absolute determinations, made by the most radically different methods, became more concordant.

The International Electrical Congress (which met in Chicago in 1893), through its Chamber of Delegates, officially representing all the leading governments, therefore adopted, as the unit of resistance, the mean of all the best determinations, the resistance at 0° C. of a column of mercury 106·3 centimeters in length and of uniform cross section having a mass of 14·4521 grammes (equivalent to a cross section of 1 square millimeter, the density of mercury being assumed to be 13·5956). The unit of resistance and the other electrical units defined by the International Congress were legalized in the United States by Act of Congress in 1894, and have also been legalized in the other countries represented.

It was generally supposed that the various governments would sooner or later take up the construction of mercury standards as called for in the definition, since each had already been provided by the International Bureau of Weights and Measures with the fundamental standards of mass and length.

The Imperial Physico-Technical Reichsanstalt, in Berlin, has already begun this task with its characteristic thoroughness. Two one-ohm mercurial standards were constructed, and later a third together with a ½ and a two-ohm tube. Widely different cross sections were purposely selected to avoid possible sources of error. The calibration and intercomparison of these standards leaves almost nothing to be desired, measurements made by two different methods, both yielding the same results within the limits of experimental error.

Twelve mercury copies were also constructed; these, together with seven working standards of manganin wire, periodically referred to the primary standards, complete the list.

In England, on the other hand, the B. A. coils have still been retained as primary standards. The legal ohm was defined in that country by the relation, 1 Siemens unit = 0·9540 B. A. unit, and later the International Ohm was defined by the relation, 1 Siemens unit = 0·95351 B. A. unit. According to a comparison made several years ago, 1 Siemens unit, as derived from the Reichsanstalt standards, is equal to 0·95341 B. A. unit, indicating a change in the coils themselves, or in their assumed relation to the Siemens unit or in both.

Matters have been still further complicated in England by the legalization of the resistance of a coil marked "Board of Trade Standard verified 1894," and adjusted with reference to the Cambridge Standards, as the unit of resistance.

A still more radical suggestion was made in that country several years ago, by Prof. A. Viriamu Jones and Prof. W. E. Ayrton, that each government adopt a Lorenz apparatus from which to derive by absolute measurements the unit of resistance. The practical substitution of an absolute method with its disadvantages as pointed out above for a purely relative one seems to be taking a step or indeed several steps backward, but may be taken as indicating the lack of confidence in the permanency of the B. A. coils.

After the legalization of the International Electrical Units it became the imperative duty of our government to provide facilities for the official verification of electrical standards and electrical measuring apparatus, especially in view of the continually increasing importance of the applications of electrical energy to the industrial arts. This function obviously devolved upon the Office of Standard Weights and Measures, already equipped for the verification of standards of length, mass, capacity, etc.

Owing, however, to the limited force and to the still more limited appropriations available for the purchase of apparatus, practically nothing could be done until July 1, 1897, when the appointment of a verifier was authorized, but unfortunately progress has frequently been interrupted for long periods by the pressure of routine work.

It was determined from the outset that it should be the aim of the office to provide facilities for measurements to any degree of accuracy likely to be set even by the most exacting demands of modern science. The first steps taken by the office consisted in working out a general plan and providing the most needed apparatus and facilities.

STANDARDS OF RESISTANCE.

To avoid the delay which would naturally arise from the construction of primary mercury standards, it was decided to refer all measurements of electrical resistance to the mean value of a number of wire coils, known in terms of the best existing mercury standards. The general excellence of coils of the Reichsanstalt type, the extremely small temperature coefficients and thermo-electromotive power with respect to copper of manganin and the permanency of coils of that material as shown by long continued observations at the Reichsanstalt, decided in favor of standards of the above description.

Four unit coils were purchased and were standardized at the Reichsanstalt, where they were kept under observation for about one month, during which period they decreased in value by about 0·0015 per cent. This, according to the maker, is the normal behavior of the material, which undergoes, after the artificial aging, a small decrease in resistance followed by a slow increase. In addition to these coils the office possesses two other coils of the same type purchased several years ago. Periodic intercomparisons between the old coils and the new ones will be made, so that any relative changes will be made manifest, the two hardly having the same rate of change. The two new manganin coils have been ordered and are also to be referred to the German Standards. On their receipt, they will furnish us positive evidence in regard to any changes which may have taken place in the preliminary standards adopted. The approximate corrections at any time can then be determined by simple interpolation.

To fix this standard, the construction of a number of mercury copies will also be taken up. The construction of primary mercury standards, which is of fundamental importance, not only from a scientific standpoint but also on account of the legal questions which will surely arise, will be undertaken as soon as time permits.

The office has acquired, in addition to the unit coils, standards of the following denominations:

1	Ohm.
1	"
4	"
4	"
3	"
2	"
2	"
3	"
3	"
3	"
3	"

The temperature coefficients of these coils were first carefully determined, then the coils of the same denomination were intercompared and the observations reduced to differences at 20° C.

The next step consisted in determining the resistance of the multiples and sub-multiples in terms of the unit. Thus, two unit coils placed in series by means of a connecting link of known resistance were compared with the two-ohm coil. The five and ten-ohm coils were similarly evaluated in terms of the unit. From the known ratio of a 10-ohm coil to one of the units, the step can be made to the 100-ohm coil by means of a second 10-ohm coil also known in terms of the unit. Similarly the values of the coils of still higher value were determined, and those of the sub-multiples of the unit, by a slightly modified method.

THE METHOD OF COMPARISON ADOPTED.

The practice in this country and in England has been overwhelmingly in favor of the Carey Foster method, but the construction of the Reichsanstalt Standards, with their terminals 16 cm. apart, makes the use of the Carey Foster bridge almost out of the question. The design of a suitable bridge capable of comparing coils of this type with those having a different distance between the terminals, introduces still further complications. Moreover, in the Carey Foster method, additional resistances are introduced in the mercury cups of the commutator which are only eliminated in a perfect mechanical construction. Besides, the resistances connecting the coils to the commutator, unless equal, are not eliminated. While the Carey Foster method is at first glance superior in being a zero method, the Wheatstone-Kelvin bridge, more simple and far less expensive in construction, excels the former especially where the intercomparison of low resistance standards is concerned, provided the coils to be compared are first made nearly equal by means of a shunt of known value applied to the greater. The value of the shunt need not even be known to a high degree of accuracy in case of fairly well adjusted coils.

The coils are connected to one another by copper forgings 1·5 cm. thick and 2 cm. wide, having therefore a resistance of about 0·6 micro-ohm per cm. of length, their terminals resting in mercury cups. To permit the comparison of coils differing widely from the standards, provisions have been made to enable one of the coils compared to be placed in parallel with an accurately known coil by means of a second pair of mercury cups.

The sources of error characteristic of the direct deflection method are due to the following causes:

1. Variation of E. M. F. of test battery.
2. Variation of galvanometer sensibility, due either to the variation of proportionality between deflection and current, or to a change in the actual sensibility.

These only affect the deflection corresponding to the unbalanced differences in the ratios of the coils intercompared, so that even if the errors in interpolation should be relatively large, the error in the ratio will be exceedingly small. With the ratios adjusted by means of shunts to within $\frac{1}{10000000}$ of equality an error of 1 per cent., five to ten times that actually existing, would produce an error of one part in 1,000,000 in the calculated ratio of the coils compared.

The Wheatstone-Kelvin bridge entirely eliminates the resistance of the parts connecting the lower mercury cups of these coils by means of shunting a second ratio coil across the resistance to be eliminated, the battery contact being transferred to its middle point. The inequality of the two halves of the ratio coil is eliminated by its reversal. The remaining sources of error are possible variable contact resistances in the mercury cups, and possible differences in the insulation resistances between them. The bottoms of the cups are accurately surfaced and these sources of error are shown to have no importance by interchanging the positions of the coils compared. Thermo-electromotive forces are eliminated by battery reversal. The heating effect of the test current was shown to be quite negligible, less than $\frac{1}{10000000}$ for a current of 0·03 ampere for one-ohm manganin coils, since a current of one ampere through such a coil produces a heating of the coil above the temperature of the petroleum bath in which the comparisons are made, of approximately 1° C.

A specimen of the results which may be obtained under rather unfavorable conditions is given below. Four one-ohm coils were intercompared in the six possible combinations, six additional measurements being made with the left and right coils interchanged, with the following results:

	Observed Differences.	Cal. Diff.	Residuals Obs.-Cal.
L R 1402—1403	= −3·8 × 10⁻⁶ ohm	−3·8	0·0
R L 1402—1403	= −3·9		−0·1
L R 1402—1404	= −4·6	−3·7	−0·9
R L 1402—1404	= −2·8		+0·9
L R 1402—1405	= −0·8	−0·8	0·0
R L 1402—1405	= −1·0		−0·2
L R 1403—1404	= +0·2	−0·2	+0·4
R L 1403—1404	= −0·6		−0·4
L R 1403—1405	= +3·4	+3·0	+0·4
R L 1403—1405	= +2·5		−0·5
L R 1404—1405	= +3·4	+3·2	+0·2
R L 1404—1405	= +3·0		−0·2

Since resistance comparisons can be made to such a very high order of accuracy, to within $\frac{1}{10}$ per cent. at least, even in the case of properly designed 0·0001 ohm standards, all interested may assure themselves that every effort will be made by the office to provide itself with primary standards of reference meeting the highest scientific requirements.

STANDARDS OF ELECTROMOTIVE FORCE.

The unit of electromotive force, the volt, is legally defined as $\frac{1000}{1434}$ of the electromotive force of a Clark Standard cell at 15° C.

The official standards of electromotive force for a government should obviously be, as far as possible, independent of any error due to impurities of the chemicals used. A large number of cells were set up with the purest commercially obtainable materials, from a number of independent sources. The work of purifying these materials by special methods was begun. Cells have also been set up with some of the purified materials, though much still remains to be done.

The intercomparisons so far made indicate a most satisfactory agreement of all the cells on hand, well within $\pm\frac{1}{2000}$ per cent. The mean electromotive force of the three dozen or more cells furnishes therefore a standard of reference which may be relied on within this limit. In addition to the Clark cells, a number of cadmium cells, having considerable advantages over Clark cells, have been set up, but owing to lack of time no comparisons have as yet been made. New cells of both types are to be added from time to time, and intercompared with the old ones to determine whether any observable changes have taken place.

The relation which the E. M. F. of the Clark cell bears to that of the cadmium cell will also be periodically determined, furnishing an additional check on the constancy of the standards of both types.

With an accurately calibrated potentiometer and reliable standards of electromotive force the office is thus prepared to undertake the verification of direct current volt-meters and millivolt-meters.

MEASUREMENT OF ELECTRIC CURRENTS.

A grave mistake was made by the International Congress in concretely defining all three of the principal electrical units, the ohm, volt and ampere, which are necessarily connected by the fixed relation $C = \frac{E}{R}$

Hence only two of the definitions are independent, the chances being infinitesimal that the three definitions satisfy the relation between them on account of the relatively large errors in the absolute determinations on which they are based. Indeed, it already seems that the volt, as defined in terms of the Clark cell, is in error by almost 0·1 per cent.

Since the standards of resistance and electromotive force, as specified by the International Congress, are certainly reproducible within $\frac{1}{10}$ per cent., the unit of current intensity, defined as the current which will flow through a conductor of unit resistance, there being unit difference of potential between its terminals, would be within the same limits of error.

Instead, it is defined in terms of the electro-chemical equivalent of silver. The voltametric measurement of a current is limited by the size of the apparatus available, and is besides impossible under ordinary circumstances with the above accuracy.

Lord Rayleigh is of the opinion that his determination of the electro-chemical equivalent of silver may be in error by as much as $\frac{1}{10}$ per cent.

Retaining for the present the legal definitions of the ohm and volt, currents may be consistently measured by the fall in potential or potentiometer method, in terms of the specified standards of reference.

It is proposed to base all direct current measurements on these principles. With suitable low resistance standards for the measurements of heavy currents and with the set of Clark cells already on hand, the office is prepared to undertake the verification of direct current ammeters within the limits practically set by the current-generating apparatus on hand.

To summarize, the office is, therefore, practically equipped for the verification of following classes of apparatus, viz.:

Resistance Standards.—Coil of the following denominations: 1, 2, 5, 10, 100, 1,000, 10,000 ohms.

Low Resistance Standards for current measurements of the following denominations: 0·1, 0·01, 0·001 and 0·0001 ohm.

Resistance boxes.

Potentiometers.

Ratio coils.

Standards of Electromotive Force.—Clark standard cells and other standard cells.

Direct Current Measuring Apparatus.—Milli-voltmeters and volt-meters up to 150 volts.

Ammeters up to 50 amperes.

For the verification of direct current measuring apparatus of even moderate range, the present facilities of the office are entirely inadequate, although now-a-days potential differences up to 20,000 volts and currents of 20,000 amperes are met with in actual practice.

Provisions must also be made for the calibration of wattmeters and energy meters.

The verification of alternating current measuring apparatus requires further facilities, and in view of the ever-increasing importance of alternating current systems, such facilities should be provided without delay.

The verification of condensers and self-induction standards also merits attention..

Another question, practically related to electrical measurements, is the photometry of arc and incandescent lamps.

Preliminary steps have already been taken by the American Institute of Electrical Engineers, looking forward to the co-operation of the office in the official verification of incandescent lamps as secondary photometric standards to enable even the moderate consumers to procure reliable standards at a reasonable rate.

The measurement of high and low temperatures will also be taken up, a knowledge of the exact thermal conditions under which certain industrial operations are conducted being of the utmost practical consequence.

There are two most reliable electrical methods based respectively on the variations of electrical resistance and of thermo-electromotive force with the temperature. Hence, with standards of electromotive force and resistance available, this subject is brought within easy reach.

No claim of originality is made in what has been accomplished. The magnificent work of the Physico-technical Reichsanstalt, at Berlin, with its staff of scientific and technical assistants and in its almost unlimited resources has been of the greatest help. It has set such a high standard of excellence that it will require years for similar bureaus, which will surely be organized by other governments, to attain.

FRANK A. WOLFF, JR.

United States Office of Standard Weights and Measures.

WALKING AS A TONIC AND PASTIME.

WALKING, says Omega, which also means standing erect, with shoulders thrown back, lungs expanded and head well poised, is the best tonic that can be prescribed for exhausted brains, weakened muscles and wornout nerves. It strengthens the digestive organs, drives the blood away from the tired brain, and is one of the best cures for nervousness.

There is no better way of curing rheumatism than by a walk in warm weather. You have all the advantages of the Turkish bath without the danger of breathing impure air. Physicians have cured the worst kinds of rheumatism, stubborn forms of indigestion, aggravated cases of insomnia and all sorts of nervous diseases by exercises in breathing and walking.

There is a famous medical man of Munich, who has formulated a system of breathing and walking by which asthmatic patients are taught to walk without using breath, while sufferers from weaknesses of the heart and nervously exhausted persons are cured. No matter how long the walk or how steep the climb, no one need "get out of breath" who follows this simple system, the breathing and walking being in time together.

In ascending a stair or path one should take one breath for every step, and the fuller the breath the better. In walking along a level stretch, one should take two steps to every breath, thus the inhalation and exhalation always begin as the same foot touches the ground.

That tired feeling which walking brings on is natural, and in a few weeks' practice one is able to walk a mile or more without fatigue. The walking is of itself a recreation and a great help to the development and preservation of physical symmetry, its tonic effects are

much better when one walks correctly and at regular times.

In order to walk correctly, one should stand quite erect, and breathe in a proper manner, then swing the leg from the hip. By so doing the muscles which are strongest bear the strain, and the length of the stride is increased several inches. The heel touches the ground first, and not the toe, and a slight spring is given from the ball of the foot to aid in making another step.

600 HORSE POWER BLAST-FURNACE GAS MOTOR AND BLOWING ENGINE.

WE illustrate below a very interesting blowing engine constructed by the Société Anonyme John Cockerill, of Seraing, and which was set to work on November 20 last. The special feature of this installation is, says Engineering, to which we are indebted for the engraving, that the motive energy is derived from the waste gases of the blast furnace. The engine has been running regularly since the above-mentioned date, and has given full satisfaction. The two horizontal cylinders are placed tandem, the blowing cylinder being behind; the piston is driven by an extension of the motor cylinder piston rod; the length of stroke is 1·400 meters (55·12 inches). The diameter of the gas engine cylinder is 1·30 meters (51·18 inches); it has a single acting piston working under the ordinary conditions of four cycle motors. The connecting-rod is 4·400 meters (14 feet 5·23 inches) long and 300 millimeters (11·81 inches) in diameter. The crank shaft is 4·60 millimeters (18·11 inches) in diameter, and is the heaviest working part of the engine, its weight being 20 tons. This shaft is supported by bearings in two large castings, between which and the cylinder, connections are made that give the engine somewhat the appearance of a large hydraulic press. A flywheel, 5 meters (16 feet 5 inches) in diameter, and weighing 35 tons, is mounted on the crank shaft, the weight being carried by an outside bearing. The total weight of the engine is 160 tons. The blowing and gas cylinders are connected by means of cast iron guide bars, much as in ordinary practice. The blowing cylinder is 1·70 meters (66·90 inches) in diameter, and the cubic capacity traversed by the piston at a speed of 80 revolutions is 500 cubic meters (about 17,650 cubic feet) per minute. The normal working pressure is equal 40 centimeters (15·75 inches) of mercury; under these conditions, the effective horse power is from 500 to 550.

The air inlet valves are placed on the ends of the cylinder, and are arranged around two concentric circles so as to afford the largest and most convenient area for the air admission. They are made of steel disks, 80 millimeters (3·15 inches) in diameter and 1 millimeter thick, and are held on their seats by spiral springs. Certain modifications are under consideration, having for their object the increase of the air pressure to one atmosphere; this would reduce the amount of delivery by about 40 per cent. The gas for working the engine is taken direct from the blast-furnace gas main; it is not purified in any way, but is only cooled in an iron chamber, 6 meters (19 feet 8 inches) long, 6 meters high, and 135 meters (49·21 inches) wide; into this chamber a spray of water is injected by a 10-millimeter Korting pulverizer. By this means the temperature of the gas is reduced to 20° C., which is found suitable for working. The running of the engine is not effected by the presence of dust or water vapor in the gas. In starting the engine the first explosion is effected by means of air carbureted with petroleum spirit; this method is found to be quite efficient, no other device being necessary. No difficulty is experienced with the packing of the stuffing boxes of the gas cylinder.

A complete series of trials with this engine will be carried out in a short time, but the practical and satisfactory test of everyday working for the last two months has demonstrated the success of the system; the amount of gas used is not excessive, and this utilization of waste gas points to a large economy in blast furnace practice. We shall hope to publish the result of the detailed trials at a later date.

DOWNIE'S PATENT PISTON RINGS.

THE marine specialties shown in the accompanying illustrations are the invention of Mr. Thomas Downie, of the firm of Messrs. Thomas Downie & Company, Toxteth Engine and Shipbuilding Works, Caryl Street, Liverpool. Mr. Downie has devoted much time and labor to the invention of piston packing rings, especially for marine purposes. The accompanying illustration, Fig. 1, shows Downie's patent high-pressure piston valve ring, which consists of one ring, having cast on the inside, where sawn, a double V slide, which is fitted with two adjustable blocks and screw.

FIG. 1.

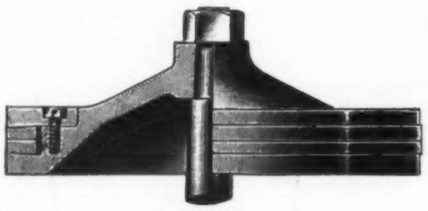


FIG. 2.

These blocks, when drawn together by the screw, expand the ring equally all round. Once the adjustment is made, the ring is locked in such a way that the steam pressure cannot affect it either internally or externally.

The advantages claimed are the great simplicity of the arrangement. There are very few parts which are easily removed, and there is equal expansion. This ring having no flanges or springs, there is no friction, and it is easily adjusted. These piston rings have been fitted to many first-class steamers and work perfectly.

In Fig. 2 is shown Downie's patent wedge-shape piston packing ring, which is specially adapted for vertical marine engines of high steam pressure and great piston speed. It consists of two rings, the one acting as a tongue-piece for the other. These rings have a standard vertical depth of 1¼ inches, and are arranged to reduce to a minimum the enormous pressure that the walls of a cylinder is subject to from steam and spring action. Each packing ring is an inclined plane on its outer surface, fitting into a corresponding one on the piston flange and junk ring; the rings are turned larger than the cylinder, then cut and sprung in, and are held in position by the junk ring. The rings at first are left a little slack vertically to allow them to wear up to the cylinder walls, and the wear on the six surfaces caused by the reciprocating action allows the packing to keep the bore full. Should this not be enough, a thin liner can be placed under the junk ring, which allows the rings to adjust themselves to the cylinder. A number of these rings have been fitted and have given perfect satisfaction.

In Fig. 3 is shown Downie's patent segment piston ring, which is specially designed and adapted for intermediate and low-pressure cylinders of marine engines. As will be seen from the illustration, the design and construction are such that the lateral pressure on the packing rings is equally distributed over the whole surface, which reduces the friction and consequent wear to a minimun. The result is a considerable saving in horse power as well as in lubricants. Owing to the lightness of these rings there is an appreciable vertical wear. They are easily overhauled by one man, and being in segments they readily adapt themselves to irregularities in the cylinder and keep perfectly steam-tight.

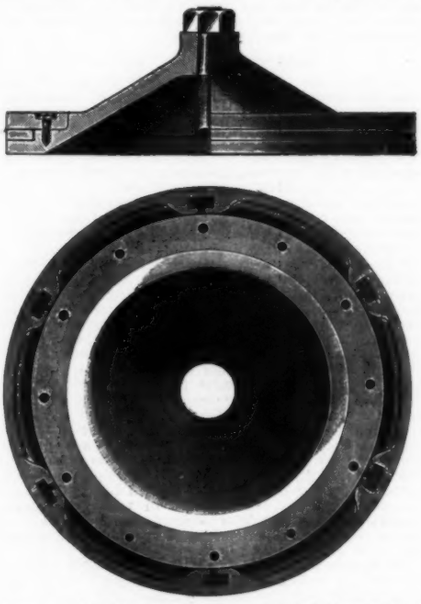
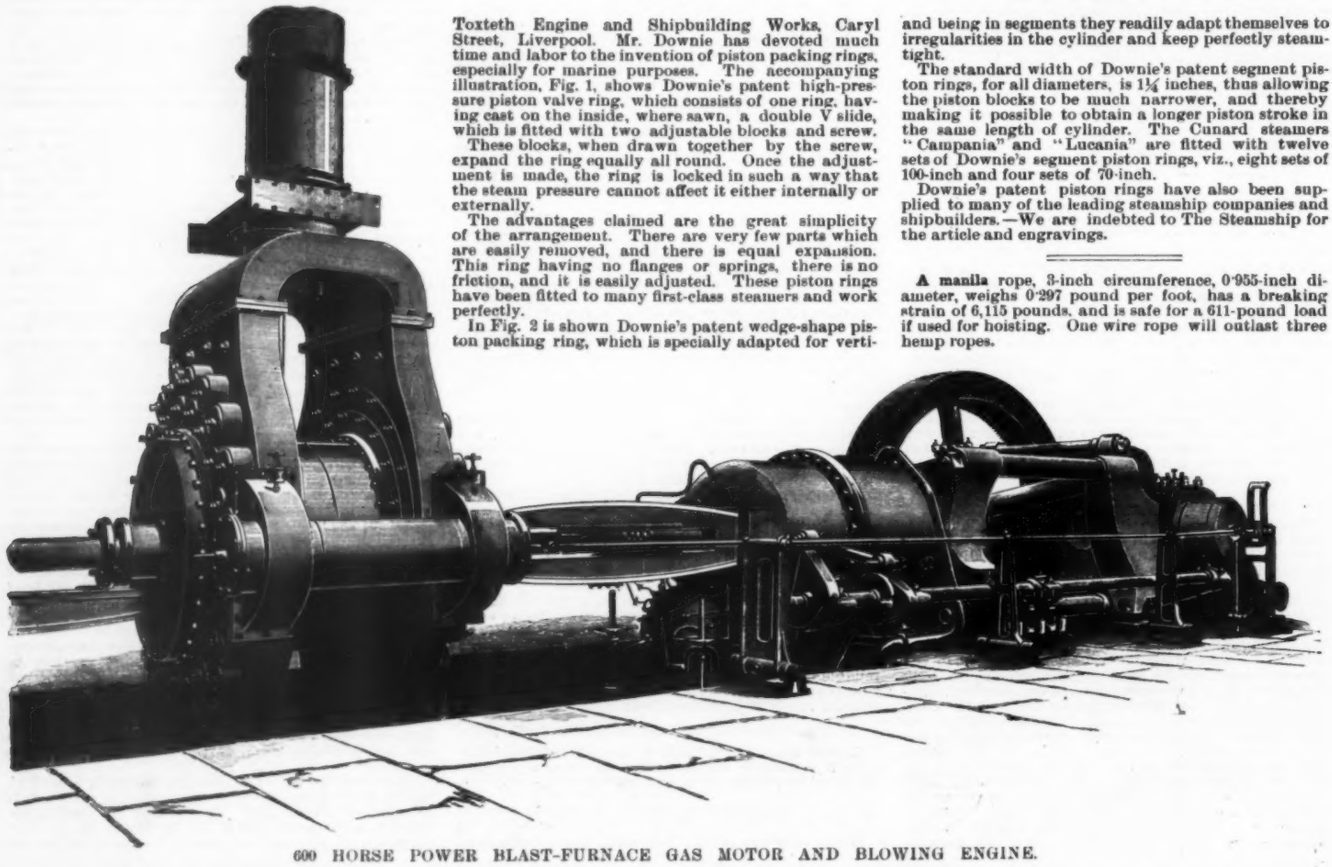


FIG. 3.—DOWNIE'S PATENT PISTON RINGS.

The standard width of Downie's patent segment piston rings, for all diameters, is 1¼ inches, thus allowing the piston blocks to be much narrower, and thereby making it possible to obtain a longer piston stroke in the same length of cylinder. The Cunard steamers "Campania" and "Lucania" are fitted with twelve sets of Downie's segment piston rings, viz., eight sets of 100-inch and four sets of 70-inch.

Downie's patent piston rings have also been supplied to many of the leading steamship companies and shipbuilders.—We are indebted to The Steamship for the article and engravings.

A manila rope, 3-inch circumference, 0·955-inch diameter, weighs 0·297 pound per foot, has a breaking strain of 6,115 pounds, and is safe for a 611-pound load if used for hoisting. One wire rope will outlast three hemp ropes.



600 HORSE POWER BLAST-FURNACE GAS MOTOR AND BLOWING ENGINE.

MACHINE FOR OPERATING A PILE DRIVER BY MEANS OF THE CURRENT OF A RIVER.

BETWEEN the two boats, *A* and *B*, which are firmly attached to each other by beams, *C*, is placed the large wheel, *D*, provided with paddles on the periphery, in order that the current of the river may cause it to revolve, and with a crank shaft at the part *E*.

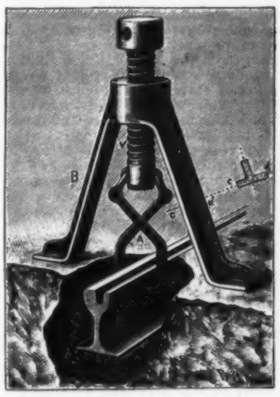
Upon these boats is erected the frame of the pile driver, which differs from the ones in ordinary use only in being provided with the wheel, *F*, and the drum, *G*, both of which have one axle, *H*, in common.

As regards the ropes of this machine, the one, *I*, that supports the monkey, *O*, has a hook, *K*, at one end, passes over the pulleys, *L* and *M*, and winds around the wheel, *F*; and the rope, *N*, being wound at one of its extremities around the drum, *G*, is attached through the other to the crank, *E*, of the axle of the large wheel, *D*. This machine is so arranged that when it is desired to use it, and the river current causes the wheel, *D*, to revolve, the crank, *E*, of its axle follows its motion. In the circle that it describes in descending from its highest to its lowest point, it pulls the rope, *N*, and consequently causes the drum, *G*, and the wheel, *F*, to revolve, and, in making such motion, winds the rope, *I*, around its circumference and causes the monkey, *O*, to ascend.

As soon as the monkey has reached the necessary height, the hook, *K*, is freed, as we shall explain, and the monkey, in rapidly falling, produces its useful effect upon the pile that it is to drive. After having seen the maneuver made by the crank, *E*, in descending, it is necessary to explain that when it rises from the lowest point of the circle that it describes up to its highest point of elevation, it slackens the rope, *N*, and, as the hook, *K*, is loaded with a block of lead and is no longer drawn upward, it descends by its own weight, and, thereby causing the rope, *I*, to unwind from the wheel, *F*, makes the rope, *N*, wind around the drum, *G*, thus putting the apparatus in a state to ascend again with its monkey, which it hooks onto after it has fallen.

Thus, the large wheel continuing to revolve, the different motions of the machine continue likewise, and, at every revolution that the said wheel makes, the monkey ascends and falls once upon the pile. It would remain to explain how the hook, *K*, frees itself from the monkey after the latter has been lifted, and how it hooks on again after it has fallen; but a careful inspection of the figure ought to suffice to show this. I shall merely add that the tail of this hook is provided with a ring to which one of the ends of the small rope, *P*, is attached, and, as this rope, which is attached through its other end to a fixed point, is tautened when the monkey is at the necessary height, it pulls upon the tail of the hook and causes it to let go its hold.

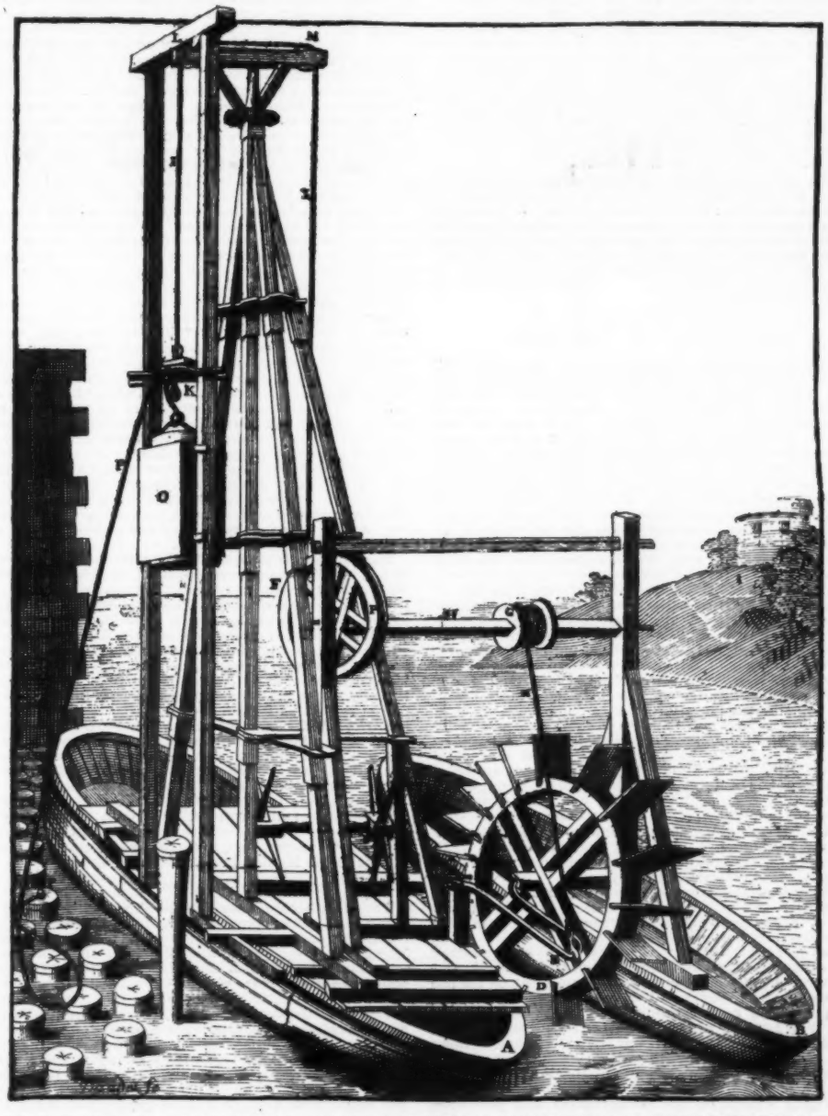
What is very peculiar in this machine is that it produces its effect continuously without the aid of any maneuver, while all other machines for the same purpose that have hitherto been invented require a large number of persons to cause them to operate. The machine under consideration might work day and night uninterruptedly, and appears to require no hand labor except that necessary to shift it from one pile to another.—From Recueil d'Ouvrages Curieux de Mathematique et de Mecanique, 1733.



APPARATUS FOR LIFTING RAILS.

APPARATUS FOR LIFTING RAILS.

THE accompanying engraving, borrowed from La Nature, represents a simple apparatus devised by a German engineer for lifting rails. It consists essentially of a screw, *V*, held by a support, *B*, a section of which may be seen to the right, at *c d*. The extremity of the screw carries a pair of tongs, *A*, the branches of which grasp the two sides of the web of the rail beneath the head. The screw is revolved by means of a lever inserted in the aperture in the head. This apparatus has the advantage over levers in that it does not necessitate the digging of a hole beneath the rail in order to obtain a purchase, and that there is no danger of displacing the rail during the operation of lifting it.



MACHINE FOR OPERATING A PILE DRIVER BY MEANS OF THE CURRENT OF A RIVER.

MACHINERY—LABOR-SAVING, LABOR-CREATING OR LABOR-KILLING?

To the Editor of SCIENTIFIC AMERICAN SUPPLEMENT:

One of the most interesting and instructive sociological works that has been given to the readers of such matter this year is a volume entitled "Better-World Philosophy," by J. Howard Moore, of Chicago. But this essayist, like so many of our philanthropical students, has viewed the issue of invention from its adverse side mainly so far as it relates to individual benefit to labor; and in opening the argument, we quote the following paragraph from his chapter on the Problem of Industry:

"Inventions are not invariable and universal blessings. The sad and peculiar conditions prevailing in human industry cause inventions to be to many human beings a catastrophe and a dread. To those who are able to own them, and have lands on which to operate them, they are blessings. But to the great disinherited class, who have nothing on earth but their hands, inventions are a disadvantage and an evil. Those who have not land or machinery must subsist on that for which they can sell the use of their bodies. Their prosperity consists in a large demand for their services. Anything that tends to dispense with and cheapen their labor is an injury to them. This is precisely the function of inventions. Their very virtue lies in lessening the necessity for labor."

It is against this paragraph that we propose to bring the battalion of combative argument with its ever evolving question of benefit versus prejudice et al. For the past century, the agitators and philanthropic reformers of social and economic conditions have flung their anathemas against the so-called labor-saving mechanical inventions that have been and that are still being showered upon our disjointed millions during the decades of the nineteenth century, through the brain-force of science and ingenuity; decrying them as a curse to labor, as a curse to the thousands and thousands of men, who, unfitted by circumstance, environment, what you will, for filling the requirements of a profession or position of skilled handicraft, must, of necessity, maintain their foot-hold on existence by what is termed common labor. Perhaps a foot-hold on par with that of the mole who burrows blindly, one of the animal illustrations which favor non-competition as non-productive of the best results to the individual mole. But can there be any fact, if it is a fact, brought forward, more uncomplimentary to the natural intellectual energy of the American workingman than the relative assertion that he must remain a mole to all eternity, as it were, that he must, of a necessity, belong to the leopard class, and cannot change his spots, in fact, is not endowed with capabilities that will permit him to change the nature or form of his work, even though it be in the line of so-called common labor. Patriotism should not be a sentiment of country alone, but of intelligence also. May we not be as patriotically true to our laborer as our land? To be sure, he can move from one State to another if he sees in the change some benefit to himself. Why can not he just as easily wield a pick as a plow, run a hand car as a hay rake, notwithstanding the fact that many of our reformers decry any such a possibility, or rather decry any invention that shall force him from his mole-like methods of gaining a livelihood?

While it is a self-evident fact that mechanical invention has displaced hand labor in a hundred instances, those who argue against such inventions seldom take it into consideration that they are only the natural results of the advancement and evolution of the horse plow beyond the sharpened stick which was once the only tool used to prepare the land for cultivation, or a period when the town crier gave to the separated habitations the only, though toilsomely gathered information or record of the events of the day, and crisis of history, which all periods, however remote, have produced—a town crier, against whom invention has placed such great odds that the 20th century world would decidedly object to having removed. And, again, that rather questionable invention, gunpowder, of which Carlyle says: "Such I hold to be the genuine use of gunpowder; that it makes all men alike tall. Nay, if thou be cooler, cleverer than I, if thou have more mind, though all but no body whatever, then canst thou kill me first, and art the taller. Hereby, at last, is the Goliath powerless, and the David resistless; savage animalism is nothing, inventive spiritualism is all. Nay, I think with old Hugo von Trimberg, 'God must needs laugh outright, could such a thing be, to see his wonderous manikins here below.'" We repeat, this gunpowder as against the much slower and more personal method of murderous warfare waged with a boomerang. To resort to alliteration, which Zangwill declares is so fast replacing epigram, particularly in politics, where its effects on moral character are tremendous, we will assert that invention may have displaced labor, but it has neither derogated nor deteriorated it.

To illustrate the theory that possibly labor-saving machinery is not an invention of the devil as against mankind, but of God, in favor of, it is only necessary to follow the transition of, for instance, one bucket of iron ore which has lain for centuries in the bowels of the earth, a valueless substance in itself, a profitless growth if unassisted in its evolution by science, until, at the invocation of invention, it becomes a mass of wonderful mechanism, awakened as it were from the inanition of ages by the kiss of the fairy prince, Genius, into an almost life-evolved being, that shall take its place as a mighty factor in the limitless train of advancement rushing on to some glorious economic fulfillment, to be deterred neither by cant nor cudgels. Aye, this handful of metallic element—metalliferous earth—you have only to watch it in its transition.

Not delving into its geological conception or discovery, we will attempt only to trace its progress from

its centuried resting place in Mother Earth to its ultimate destination as man's assistant. In the first place, how many thousand men are gaining, at least, the substance of a good living for themselves and their families by digging the treasure from its cavernous home? Enough, at least, who, were they distributed as tillers of the soil broadcast over our country, would be the means of starting another howl of overproduction through the land, but in this instance, human instead of manufactured production, which would perhaps justify the present administration's policy of ignoring the constitutional Monroe doctrine. And next in transition, we find this bucket of ore in the hands of the carriers called railroads. Here again in evidence, we must take into consideration the strongly proved fact that the railroad employes form a formidable majority in the great league of common laborers. The great labor-giving system is certainly of mechanical device, a system of machines, and it returns to us that some other little bucket of ore and its fellows made it possible for the mighty factor, the railroad, to retain its profitable existence. Following our illustration, we find it has now only arrived in cars to its center of export, although it has taken as many pairs of hands to get it there as there are voters in a great city, and again it must have its thousands of helpers, ere it is safely landed in the care of the great transportation companies, where we have further incidental evidence of the multitude of employed labor which is required in the manufacture and management of the hundreds of steam and sail navigators which throng the chain of lakes. Necessarily these represent an unlimited amount of skilled labor as well. Next comes its arrival at some seaport town, where it must again be lifted from the hold of the vessel to the miles of dock front, which too, in turn, as well as the assisting machinery which has taken so prominent a part in its transportation, has given millions of dollars into the hands of labor. From the dock it is again transferred to the railroad, where still again thousands must come to its aid, it not yet having arrived at a stage that will allow of its discharging common labor and taking on skilled operators. Next comes its arrival at the great furnaces and mills scattered over the country, where is separated the false from the true, through purification by fire. Now our little bucket of ore has become a molten mass whose product is the bar of iron. How many thousand furnace workers, think you, will our next census enumerate? Again into the hands of the common carriers, and the bucket of ore, now a bar of iron, is whirled away, and, as it is still but an inert mass of metal, human hands and ingenuity must aid in its flight. But next we find it in the hands of skilled labor, almost exclusively, guided in its many and devious wanderings by the brain power of mechanical genius, a genius which is one of the grandest and most beneficial gifts that a good providence has seen fit to shower upon his earthy representatives. And from this point, it is more difficult to follow our transfigured original, unless we individualize, which has passed into forms of such dainty, frail, and wonderful mechanism that it seems as though they were endowed with human sensibilities. And in this last transition to a completed whole, is represented all of the finest acquirements of human skill, ingenuity, and delicate handicraft, as well as intelligence and inventive artistic force, an immense whole, as it were, of beauty and practicability, and this completed labor-saving machine—has it not, from birth to maturity, given work to its countless thousands? If it were possible to tabulate the individual labor, time, etc., expended on one machine during its period of transition, how would it compare in utility, as regards the principle of for and against its beneficence toward the man who must labor by the sweat of his brow? And remember, this bit of ore is only one of the many developing transitions at which labor, i. e., common labor must assist. It is saying nothing of gold, silver, and the other metals, that grow under the earth, nor of the many productions that are on the surface, that require just as much expended "common labor" before they can become a perfected evolution.

To individualize, we will further quote from Mr. Moore's Problem of Industry:

"A type-setting machine performs the same kind and quantity of work as five men. A Hoe printing press will cut, print, fold, and address 55,000 newspapers in an hour, an achievement which two generations ago would have required 300 men. A modern match-making machine will perform the entire process involved in the manufacture of matches, from sawing the timber out of which they are made to counting and boxing them, at the incredible rate of 6,000 or 7,000 a minute."

The type-setting machine does the work of five men, yet we have just followed one bucket of iron ore to its result, i. e., a type-setting machine. The labor of five men saved; but what would our tabulated estimate figure out as labor created? The Hoe machine sets out 55,000 newspapers an hour. Watch for a few moments the complicated workings of the Hoe machine, and remember our bucket of ore, which, with its accessories, carbonated iron and wood, which has opened another field of labor product, whose evidence is becoming superfluous in our argument. And the match machine, which represents in its creation more steel, wood, and buckets of ore, and this constant reiteration is ruinous to one's tautology, but we repeat, remember our bucket of ore and "the pit from whence it was digged," or would it be better that we resort to the ancient regime, when fire was drawn from the sun, than produce a match machine which will furnish us matches at the rate of 6,000 or 7,000 a minute? Will not the united voice of labor cry as with one grand halleluiah, "Blessed be the name of the man who invents!"—even though it be a machine that does the work of five men or five hundred.

There is another illustration that should furnish a strong argument for some fair advocate who will take the stand against labor-saving machinery, as it relates to the feminine branch of society, and that is, the passing of the tallow dip in favor of the modern labor-saving methods of illumination. The time was, and at no great distance either, when many of our grandmothers constructed, monopolized, and controlled the entire illuminating plant of all families, and often that of the entire neighborhood, in the manufacture of the "dip." But now her opportunity for that occupation, like Othello's, "is gone," and through the means of labor-saving machinery at that. There has been no perceptible decrease in grandmothers that we have learned of, but through man's intervention and invention the "dip" has been supplanted by oil, gas, and lastly by electricity, but who cries out for protection for grandmother labor, or the "dip"? Perhaps it is only the meek humility of the feminine that keeps her silent.

One of the most prominent writers of the day has written the following paragraph, which "shows up" invention from his point of view:

"The steam plow and the reaping machine are creating in the modern world latifundia of the same kind that the influx of slaves from foreign wars created in ancient Italy. And to many a poor fellow as he is shoved out of his accustomed place and forced to move on, as the Roman farmers were forced to join the proletariat of the great city, or sell their blood for bread in the ranks of the legions, it seems as though these labor-saving machines were in themselves a curse."

Hardly has this man taken into consideration the benefits accruing to labor from inventions of a labor-saving nature, not only to individual labor, but by its thousand devices and helps, been the vital means of giving to the laborer and his family the benefits of such inventions, in the reward of luxuries as well as comforts, that he could never have possessed without their aid, making even the rough road of poverty softer to the weary feet that needs must traverse it, so long as social conditions remain as they are, and the child is not yet born that shall see the change, however desired, for social like natural evolution works but slowly though surely. The late Henry George, one of the most enthusiastic land reformers of our day, and a man whose opinions will always command respect from the thinkers of the world, though many will differ with him in policy, has hurled many strong invectives against inventions of a labor-saving nature, and he too, fails to give due consideration for the amount of labor created, both skilled and common. He says in his Social Problems:

"The great employment of machinery, the greater division of labor, the greater contrasts in the division of wealth, become to the working classes positive evils, making their lot harder and more hopeless as material progress goes on."

And further to illustrate, he holds up the Chinese non-advancement principle for our observation:

"It is not altogether from blind dislike of innovation that even the most thoughtful and intelligent Chinese set their faces against the introduction into their dense population of the labor-saving machinery of western civilization. They recognize the superiority which in many things invention has given us, but to their view, this superiority must ultimately be paid for with too high a price. The eastern mind, in fact, regards the greater powers grasped by western civilization somewhat as the medieval European mind regarded the powers which it believed might be gained by the Black Art, but for which the user must finally pay in destruction of body and damnation of soul. And there is much in the present aspects and tendencies of our civilization to confirm the Chinese in this view."

However, had Mr. George lived but a few years longer, his own illustration (according as events in China are pressing forward) would have gone over to his natural enemy, the inventive genius. In summing up the pros and cons of the case we must at last arrive at the conclusion that the fittest shall survive, in spite of all, and that the capabilities of labor will, as it ever has, advance in line with the world's requirements, be it for or against machinery. ALBERTA A. FIELD.

Ashtabula, Ohio.

THE POISON IN OUR FOOD.

AN eminent French chemist wrote a book not long ago in which he made a forecast of the time when human beings would cease eating meat or vegetables, and would take all their foods in the shape of compact chemical tablets of diverse flavors. It is possible that the day may come when chemists will be able to manufacture nutritious and wholesome food out of the elements; but if we are to judge the future by the present, it is to be hoped that the era of chemical food may be postponed indefinitely. It has long been known that a very large percentage of our food is more or less adulterated with substances that can be made to resemble it in appearance and flavor, and which are often harmless. If they were all innocuous, the question would be merely one of commercial honesty, competition, and price. But many of them are injurious to health, and therefore call for more vigorous measures.

As early as 1820, attention was called in England to the dangers from adulterated food through Accum's treatise, "Death in the Pot." In 1851, The Lancet declared war against dishonest manufacturers, printing every week a list of culprits, with chemical analyses of their products, and continuing this for three years. Repeated legislative enactments since that time have given the English considerable protection, but that it is still far from complete may be inferred from an article in The Lancet of April 22, on "Meat Extract of Vile Origin," which shows that such extracts are occasionally made of putrid liver and offal. "It might be thought impossible," it remarks, "that such filthy material could be fabricated into a toothsome paste, but so it is, the use of deodorizers and subtle flavoring materials having been placed at the disposal of offal-mongers by the advances (alas, that it must be so confessed) of chemical knowledge. . . . Of course, cooking would destroy most noxious germs, but their products, the poisonous ptomaines, would remain. . . . Their presence in an extract would cause very serious symptoms of poisoning."

In this country many State legislatures have enacted laws making injurious food adulterations illegal, and Congress has set aside an annual appropriation for use in investigating such adulterations, partly for the sake of protecting honest producers. The proceedings of the War Investigating Committee have resulted in a fiasco for the government, but they have at least done good in calling the nation's attention in a sensational way to this subject of "Death in the Pot." By a fortunate coincidence, official reports regarding the alarming extent of food adulteration and poisoning have been recently prepared in several States, and the result is that the press all over the country is discussing this matter.

In Pennsylvania the Food and Dairy Commissioner, Levi Wells, has ascertained that chemical companies have had agents traveling regularly in the State to sell to butchers chemicals for preserving meats, the favorite being apparently boracic acid, which "is certainly deleterious to health." The packages are labeled, telling how the chemicals are to be used on meat. In Connecticut the Agricultural Experiment Station issued on May 1 its annual report on the adulteration of foods. It gives a summary of the extent to which frauds are practiced on consumers, thanks to Yankee ingenuity, combined with modern advances in chemistry. Of sixty-three samples of fruit jellies, two-thirds were adulterated, not only with starch and glucose, but with aniline dye and poisonous salicylic acid. Out of forty samples of marmalades and jams only three were pure. Of forty-seven samples of beer and ale, twelve contained salicylic acid, and nineteen samples of sausages and oysters were found "embalmed" by boric acid.

"The use of antiseptic as preservatives of food is becoming alarmingly great," says Prof. Mitchell, analytical chemist of the Wisconsin Dairy and Food Commission. Farmers mix them with milk and butter, and they act disastrously on the tissues of the stomach. Nearly every butcher in Illinois, he says, makes use, especially in the preparation of "Hamburger steak," of preserving chemicals, including sulphide of soda, a compound which checks fermentation, and therefore makes it difficult to digest the meat. A government expert has testified that this chemical had been used by medical students to preserve cadavers, and by physicians to disinfect houses where there had been smallpox. At the recent sessions of the United States Pure Food Investigating Committee in Chicago, the testimony of several other experts was taken, all of whom agreed that the antiseptic chemicals so freely used in the preservation of food and drink are deleterious, and in many cases poisonous. Dr. Wiley, chemist to the National Agricultural Department, declared, among other things, that no food which contains preservatives is fit to eat, and that probably the one most commonly used, because of its cheapness, is salicylic acid, which should be forbidden because it is very bad for the health, especially in the case of weak stomachs. A pamphlet published by the Department of Agriculture at Washington states that "the use of salicylic acid as a food preservative has been forbidden by several European governments." Here it is used to a large extent, both by native canners and by foreigners who take advantage of our situation. The department found it in fifteen out of twenty samples of string beans, in ten out of twelve samples of baked beans, in twenty-four out of forty-one cases of corn, and so on.

This testimony, from so many expert and unbiased sources, fully justifies the heading given to our article. The chemicals used to preserve our food and drink have become a serious menace to health. There are thousands of invalids whose chances of recovery and life depend on their getting the purest drugs and food, and there can be no doubt that some of these are killed every day by the poisons in milk, butter, and meat, put there by farmers, grocers, and butchers to save trouble or avoid the risk of goods spoiling on their hands. To perfectly robust individuals these chemicals may be comparatively harmless, but Americans are a nation of dyspeptics, and salicylic acid, the favorite preservative used here, has been pronounced by the Paris Academy of Medicine especially injurious to dyspeptics. Their life is made wretched by the systematic food poisoning for the profit of dishonest dealers; salts of zinc or copper in a dish of canned peas, for example (put there to give them a pretty green color!), may result in a sleepless night, colic, headache, loss of a day's work, and general misery; and this may go on indefinitely, rendering life a burden, without any suspicion in the victim of the real cause. Last summer a Western hotel lost hundreds of guests, who left, one after the other, because they all became ill for some mysterious reason. The water and ice were held responsible, but careful experiment showed that the illness was due to the use in the kitchen of cheap coal-tar flavoring extracts. In saving $10 by buying this stuff the proprietor of the hotel lost $10,000. These coal-tar extracts are used to a very great extent in confectionery, ice cream, soda water, etc., and to many persons they are poisonous. They deserve a special investigation.

To remedy this state of affairs it has been suggested that a national food commission should be organized with powers to examine manufactured products and testify as to their quality. The most important thing to remember, if this is done, is that fines are of little use, imprisonment of the real culprits being the only effective deterrent. This was proved in Munich, where the law that only hops and malt must be used in the manufacture of beer was ineffectual as long as the brewers were simply fined, for they found that it was more profitable to make poor beer and pay a fine than to make good beer and pay no fine. But when the government began to imprison the rich brewers, they began to make honest beer. Pending the enactment of similar laws in this country, covering drink and food, there is a method which can be applied at once by honest manufacturers and dealers. Let them print the contents of their cans on the labels, offer rewards for discovery of adulterations, and advertise on a large scale in the newspapers, and they will become as prosperous as the Munich brewers.—The Nation.

The manufacture of brick from blast furnace slag is being successfully practiced by the Bohemian Mining Company at the Karl-Emil works in Bohemia, says The Engineering and Mining Journal. How the consumption of this kind of brick has increased is best shown by the increase of production, which rose from 200,000 bricks in 1888 to 12,100,000 in 1895. In the Karl-Emil blast furnaces limonite of the Bohemian sub-silurian formation is worked by means of coke, whereby slag of the following composition is produced: Silicic acid, 25·8 to 27 per cent.; peroxide of iron, 1·7 to 1·5 per cent.; clay, 17·3 to 19·3 per cent.; lime, 51·4 to 51·5 per cent.; magnesia, 2·5 to 0·4 per cent.; sulphur, 1·3 to 1·8 per cent. This slag, mixed in granulated condition with caustic lime, hardens to a cement-like mass, from which the so-called slag brick is produced. Such a brick weighs about 10 pounds and can theoretically

bear a burden of 38 pounds per square centimeter. The production of these bricks is at the rate of 1,000 per hour. After having dried eight days the bricks are ready for shipment. The hardening process is accomplished by the silicic acid of the slag combining with the lime additions that are made during the process of manufacture, and the hardening of the latter itself by absorption of carbonic acid. The works mentioned also use spathic ore which produces a dark colored slag. Dark slag, however, has not proved as suitable for the manufacture of brick as the light-colored slag, because its lime content is lower, and for this reason a larger addition of time is required for producing a batch of the proper consistency. Besides, brick from dark slag has to be dried for about three months before it is hard enough for shipment.

A SIMPLE ILLUMINATION PHOTOMETER.

THANKS to recent developments in lighting the question of intensity in illumination is pretty satisfactorily answered; incandescent gas lighting and the electric arc lamp are both relatively economical sources of light, and acetylene in a few years may be added to these high candle-power illuminants, so that the intensity of the light source is no longer the point striven for. In fact, these light sources are too intense when looked at directly and the issue now resolves itself into one of illuminating effect rather than intensity. It is better to have many small lights distributed along a street than to have a bright lamp at each crossing, because the illumination is more regularly distributed, and with inclosed spaces any arrangement that will make the illumination resemble "a solid block of light," and thus more nearly seem like diffused daylight, will be the most perfect.

The tendencies in this direction are amply evidenced by the ground glass and opal globes and shades now so common in connection with interior illumination, diffusing the light which would otherwise be painful to the eyes and making it mellow and pleasant.

There are two methods of attaining this end, either the light is inclosed in a globe and penetrates through it, losing about half its intensity by absorption, or the light is thrown by projectors or reflectors upon large surfaces from which it diffuses in all directions. Examples of the latter method are not as common as they will be after diffused and indirect illumination have been more extensively introduced; however, one frequently sees inverted opal shades which reflect the light into the ceiling and let part pass downward through the glass; less frequently do we see it thrown against side walls, and there is but one example, although a strikingly beautiful one, of light projected against a diffusing surface. This latter method will be found in the dome of the magnificent library of Columbia University (New York), in which is suspended a 7-foot sphere painted white, and against which are thrown the light of eight arc lamps of 5,000 candle-power (25 amperes and 116 volts) each, shunt regulation. The projectors are the ordinary stereopticon system consisting of a condenser and objective of long focus, the distance to the globe being 60 feet. As much of the globe as can be seen is thus illuminated with considerable intensity, so reduced by the time it reaches the floor that the globe looks like a large moon against its dark blue dome.

This system is unique, and the effect is strikingly beautiful, producing no sharp shadows and lighting up the frescoes and stone carving in such a manner as to give them the soft roundness that they have by daylight.

Mr. Vanderbilt's private picture gallery is another example of novel diffused illumination, the light from concealed incandescent electric lamps being thrown by reflectors upon a white screen stretched horizontally across the room under the skylight, diffusing the light so uniformly that no bad reflections or dark places were found on any of the paintings.

These and similar examples of modern illumination mark the line of progress in lighting, so that it is illumination we have to deal with and not candle-power, in other words we now want to know how much light a surface receives and gives out and not so much what intensity of light any single light source radiates. In following up this idea it became necessary to measure illumination and to secure a photometer for this purpose. In order to test the illuminating powers it was decided to construct an illumination photometer upon a simple plan, easy to make, easy to operate, and cheap.

The photometer consists essentially in a horizontal piece of heavy white bristol board having a hole in the center three-fourths of an inch square; a piece of cardboard from the same piece is placed at an angle of 45 degrees below this and the surfaces of both slightly wetted with a brush to remove the glazing and produce a "dead white" surface. This arrangement rests on a narrow board about 4 feet long, upon which a sperm candle is placed so that its light falls upon the 45-degree surface, which is observed through the square hole from above. The candle is moved in or out until the horizontal and the inclined surfaces seem to blend, the eyes being kept preferably nearly closed during observations, especially with electric light. The arrangement is illustrated in the accompanying drawings.

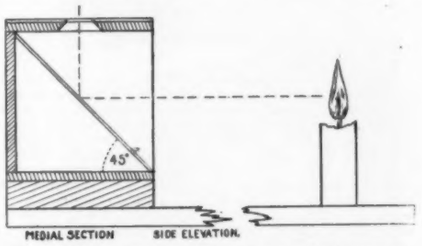
It must be remembered that when we measure illumination we are not determining candle-power, the unit in the first case being a foot-candle, while in the second it is simply an equivalence to a standard candle, the one is the effect and the other the cause. We usually judge of illumination by the light upon a horizontal surface placed at a specified height and location; this height is usually about 30 inches above the floor and is supposed to represent a book, drawing, or other work lying flat upon a table. Although a horizontal surface is not by any means the only one to be illuminated, yet it is more frequently so than any other position, as it is usually the one upon which the most trying work is done, and such work is usually carried on upon a desk, table, or bench. If a light is sufficient for these conditions it is liable to be enough to meet other demands.

A foot-candle is the illumination which a white surface receives when placed vertically at a distance of 12 inches from a standard candle burning 120 grains of spermaceti per hour and having a flame 45 millimeters high. As the illumination varies inversely with the square of the distance from the candle, if placed at a distance of 24 inches, the illumination of the same surface will be one-fourth of a foot-candle and so on. Standard sperm candles, however, are too expensive for ordinary use, so that the ordinary sperm candles sold by grocery stores must be pressed into service. They are about equal to a metric candle (one-tenth of a carcel) or 0·96 English standard sperm candles when the flame is 1·75 inches high. The various standard units in use are:

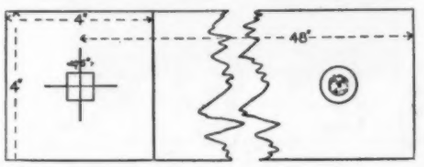
STANDARD UNITS OF LIGHT.

Country Where Standard.	Standard Candles. Name.	Material.	Equivalence in English Sperm Candles.	Standards of Light. Name.	Equivalence in English Sperm Candles.
England and United States....	English candle	Spermaceti	1·00	Candle	1·00
France.....	Star "	Stearine	1·20	Carcel	9·63
Germany..	German "	Paraffine	1·05	Hefner lamp	0·88

Paraffine candles contain oil which raises their intensity above 1·05 and stearine candles vary much, so that it is better to use a good sperm candle in photometric tests.



SECTIONAL ELEVATION OF PHOTOMETER.



PLAN VIEW OF PHOTOMETER.

Having constructed a photometer according to the design here submitted and bought some sperm candles it remained but to graduate the instrument. If we let A = the standard foot-candle, (Fig. 1) be removed 12 inches, and a = the foot-candle desired, at a distance of x inches, then:

$$\frac{A}{a} = \frac{12^2}{x^2} \text{ or } x = \sqrt{\frac{144}{a}}$$

From this equation we construct the following table and plot the results in the dotted curve in the accompanying diagram: (Fig. 1).

Foot Candles. a	Distance, Inches. x	Foot Candles. a	Distance, Inches. x
0·1	37·9	1·8	8·9
0·2	26·8	2·0	8·5
0·3	21·9	2·25	8·0
0·4	18·9	2·5	7·6
0·5	16·9	2·75	7·2
0·6	15·5	3·0	6·9
0·7	14·4	3·29	6·6
0·8	13·4	3·5	6·4
0·9	12·6	3·75	6·2
1·0	12·0	4·0	6·0
1·2	10·9	4·5	5·6
1·4	10·2	5·0	5·4
1·6	9·5		

This scale, however, cannot be applied directly to the photometer bar as there are many factors, such as a deviation of the 45-degree screen from that angle, a slight difference in the cardboard surfaces, or the effect of insufficient blackening of the interior of the box, which would prevent such a theoretic application.

It is, therefore, necessary to calibrate the photometer bar, which, by the way, also makes the reading independent of the candle-power of the sperm candles used in calibrating, provided these candles do not vary among themselves, and that their actual value in candles is substituted for A ($A = 1$ in above table).

The process of calibration is simple. Place the photometer on its side upon a dull colored carpet or cloth and one candle (a) in a line perpendicular to the top surface of the photometer at the outer edge of the square opening, placing a velvet screen at some distance behind the candle so that the latter will not be seen when the eye looks through the square opening in a line perpendicular to its center. Across the square opening are drawn two central axes in pencil, not too dark, and lines are also drawn upon the 45-degree surface in such a manner that when the line of sight is perpendicular to the center of the square opening, these lines will seem to be continuous, or contrarywise when the lines seem continuous, the line of sight (using one eye) will be perpendicular, as it should always be. The other candle (b) is placed in a line parallel to the photometer bar and passing through the intersection of the cross lines on the 45-degree surface.

Now, if the first candle (a) is placed at the several distances (x) from the top surface given in the above table, this surface will be illuminated with the corresponding number of foot-candles under the column (a). If then, the other candle (b) is moved back and forth until the inclined surface seen through the square opening seems to blend with the top surface, the illumination of the two surfaces will be equal, and the given number of foot-candles is recorded at that point on the bar; similarly for the other points. After each observation see that the flames have been the same height and reverse the candles until a point is obtained which is a good average. Having found a number of points a curve may be drawn similar to the one here shown and the intermediate points taken from it, thus saving a long series of tedious observations.

In observing, the best results are obtainable by keeping the eyes closed so far that all detail is obscured; in this way nothing but the luminous effect is obtained, and the trouble due to the difference in color between the reddish yellow flame of a sperm candle compared with the slightly greenish tinge of a Welsbach burner, the white light of acetylene, or the pale light of electricity is largely obviated, in fact it is very difficult to obtain any results otherwise. A pair of sun goggles having an India ink tint has also been used when the powers are high with good results.

To take an observation place the top of the photometer box horizontally at the place whose illumination is desired in such a way that the light source does not shine into the box. Look down upon the box from a position which casts no shadows upon it and move the candle back and forth until the two surfaces blend, a point easily determined after a little practice, and the foot-candles of illumination can be read from the bar direct.

This photometer works very well, and is so simple that it can be built almost anywhere and at very short notice. Care must be taken, however, to keep the height of the flame about 1·75 inches and in line with the center of the inclined surface. The flickering of candles may be reduced by placing a chimney an inch or two above the top of the flame. If preferred, some other method of lighting may be used, always supposing such light to remain constant and equal to its comparison light during calibration, and that its true value (A) in candles be substituted in the preceding formula in place of unity.

For ordinary purposes an illumination of 0·80 foot-candles is sufficient, although for reading, writing, drawing, working with dark materials, etc., a foot-candle should be provided. Very interesting tests can be made by using various shades placed in various positions and heights, the object being always to secure the highest illumination effect possible, along with the greatest attainable uniformity. The hygienic importance of such lighting cannot be overestimated. The greatest injury is done to the eyes by the muscular adjustment necessary in turning repeatedly from an intense light source to a dark part of the room and back again, which not only fatigues the eye but the brain as well, and ultimately causes permanent injury to both. When a room is uniformly lighted by say 0·60 foot-candles, under the conditions previously stated as to height and position, it will seem sufficient to anyone entering the room without photometric intentions; if the same person enters at another time a room lighted to 1·00 foot-candle it will also seem sufficiently lighted and will not strike the observer as being very much lighter, unless they are placed side by side. This peculiarity is due to the diffusion of light which makes it easy on the eyes. However, enter a small room having a 25-candle naked gas flame and, subse-

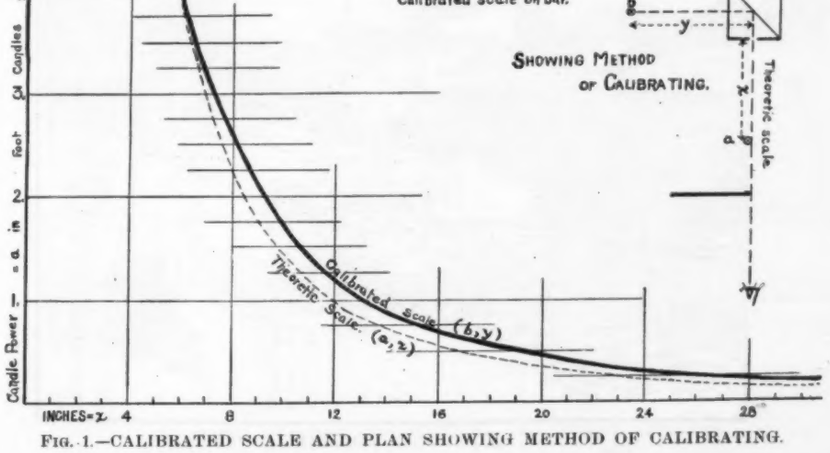


FIG. 1.—CALIBRATED SCALE AND PLAN SHOWING METHOD OF CALIBRATING.

quently, another larger one with a 50-candle open Welsbach burner and the difference is noted unconsciously, principally by reason of the intensity of the light source; although the average illumination may be lower in the latter case it will seem brighter by reason alone of the intense light source, and the difference will be noted only after endeavoring to read or sew for some time in both.

The use of a photometer will remedy many lighting annoyances, and will, in some cases, dispense with surplus lights, in others demand shades or reflectors, and in still others demand more lights or a change in system altogether. There is comparatively little work done along these lines, it being a matter of guessing with most architects, although Siemens gives the rule that 5 square feet of floor require one candle when the ceiling is 8 feet high, while Wybava says 3·6 square feet when the ceiling is 10 feet high.

ART AND FASHION AMONG THE PAHOUINS.

THE M'fan or Pahouin people are a horde of invaders. It was not until 1872 that they made their appearance upon the west coast of Africa, after crossing nearly the entire width of the Continent, and driving back and absorbing, in the literal sense of the word, the different tribes whom they met upon their way. They now occupy the vast territory comprised between the Cameroun and Setté-Cama, that is to say, more than 150 miles of French coast.

In coupling the words "Art" and "Pahouin," we must certainly evoke a very deep and justifiable feeling of astonishment in the minds of the old colonists. Etymologists tell us that the word pahouin signifies "savage." This is a statement in which there is nothing unreasonable, although it is simply hypothetical. The Pahouins always live as true children of the brush. They fish, hunt, scratch off their vermin, love or beat their wives and make war; and these are about their only occupations. A certain number of them continue to be, what Mandat-Grancey calls "believing and practicing anthropophagites."

In their own carnal envelope, the Pahouins see a frame admirably adapted for the execution of their artistic conceptions, to carry out which they utilize their teeth, their hair, and their skin. If they cut their incisors and molars to a point, it is not only in order to consume with greater ease the special dishes of the national cuisine, but especially in order to perpetuate a fashion several centuries old. Moreover, the effect of an operation of this kind is quite happy. It flatters the lover of local color, in that it harmonizes wonderfully with the general character of the M'fan people, while picturesquely recalling their old reputation for cannibalism.

The Pahouins ornament their face and their trunk with blue and red tattooings, and also with others (and these they most delight in) that appear in relief. These latter are produced with the juice of a certain plant which, when introduced into a series of small incisions, has the property of causing the flesh to grow in ridges. Unfortunately, whatever be the nature or color of these tattooings, they are all of a purely ornamental design. There is never a "genre" subject like those displayed in so much detail upon the shoulder blades of the Japanese, and never a sentimental or obscene sketch such as we see upon the biceps of our sailors; nothing but dots, lines or arrows that are placed above the upper part of the nose, open out like a fan upon the cheeks, run across the chest, and radiate upon the abdomen, which is already ornamented with some well-grown umbilical hernia by way of a central motive.

A PAHOUIN DAMSEL.

Not content with tattooing themselves, some of the aborigines paint their face bright red with the powder of a certain dyewood; but this custom is less widespread among the M'fans than it is among the Loangos. Among these latter, the "Calebasses," or damsels who are to be married, show themselves to be particularly addicted to this practice. They conceal their youthful faces under a dull pulverulent mask, similar in appearance to coagulated blood, and, during the period of mourning, superpose upon this first coat of red a second one of powdered charcoal.

After having added to their natural ugliness by these different artifices, after having smeared themselves with palm oil and perfumed themselves with wild garlic, the Pahouins bedeck their body with certain ornaments, such as amulets, shells, the teeth or horns of animals and collars of pearls or glass trinkets, without forgetting the famous "fetich of personal safety" composed of two bells, one of which, without a clapper, contains a small piece of a human heart or brain enveloped in black wax. The women encircle their limbs with huge bracelets of copper, several rows of which they wear upon the forearm, on the wrist, and below the knee. Some of these rows include no fewer than fifteen rings.

Considering the prominent place that it occupies in the human countenance, the nose, more than any other part of the body, deserves to be ornamented with taste. Of this opinion are the Pahouins, those at least whom the proximity of the whites has not caused to lose respect for sound traditions. The Betses of the Arebe, an affluent of the Como, transpierce the organ under consideration with fish bones, while the dwellers upon the Okano, disciples of another school, prefer to use colored pearls for the decoration of the nasal appendage. Some women, through pure coquetry, and without cherishing the least project of feminine emancipation, decorate their face with threatening moustaches, by introducing a few hairs from the tail of an elephant into their nasal passages.

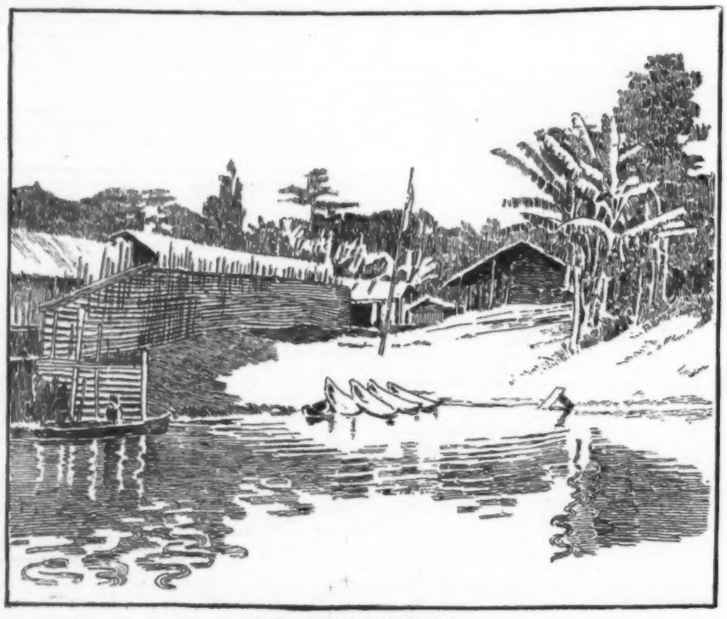
A PAHOUIN CHIEF.

PAHOUIN HEAD DRESSINGS.

It is in their headdress that the Pahouins display the most fantasticalness. They have hundreds of ways of arranging their hair. The simplest consists in converting their cranium, completely deprived of wool, into a round ball apparently coated with lampblack. The most complicated has the effect of giving the head the aspect of a garden laid out by a skillful hand, in which the paths in crossing each other form varied contours upon the borders.

If, from the question of hair, we pass by a very natural transition to that of headgear, we find that the principal motive, and, in a manner, the basis of ornamentation in the Pahouin headdress, is the classic white porcelain button provided with four holes. This modest object is used for a more utilitarian than artistic purpose in old Europe, since it serves there for buttoning shirts, drawers and flannel waistcoats. But what we civilized folk regard as mere vulgar accessories of the toilet, these savages consider charming jewels. They know better than we do how to appreciate their unobtrusive luster, and their lunar form at once so decorative and simple. They strew them with profusion over all their headdresses, and yet, says Prudhomme, the headgears among these warlike people are military. They are merely two cornered hats, leather helmets, and caps of monkey-hair. The hair caps have a front piece cuirassed with an envelope of buttons sewed on close together without any interval. Upon one of them there have been counted more than 350 between two long pendants of blue and red pearls.

HELMETS OF PAHOUIN WARRIORS.



A PAHOUIN VILLAGE.

We are, perhaps, expatiating at too great a length upon the different accessories of the costume before speaking of the latter itself; but it must be confessed

that habiliment, properly so-called, is always of the most scanty nature among the Pahouins. Around the loins they wear cotton drawers of varying length, sometimes replaced by a girdle of bark, or the skin of a monkey or "ncheri" (small antelope); that is all. The women, like the warriors, leave all the upper part of the body exposed. Their modesty is awakened only when they meet with a white person. Then, like Eve after her sin, they perceive that they are naked, and hasten to pluck a few leaves from the first shrub that comes handy, in order to cover themselves therewith.

The chiefs, very eclectic in their tastes, readily abandon the national costume, or, more properly speaking the national semi-nudity. They take pleasure in putting on all the old uniforms brought as presents by explorers, and all the worst cast-off clothing picked up

FETICH AND BOXES CONTAINING ANCESTORS' SKULLS.

COMB AND PINS.

in factories. They disguise themselves, with equal pleasure, as zouaves, clowns, firemen, English generals, etc.

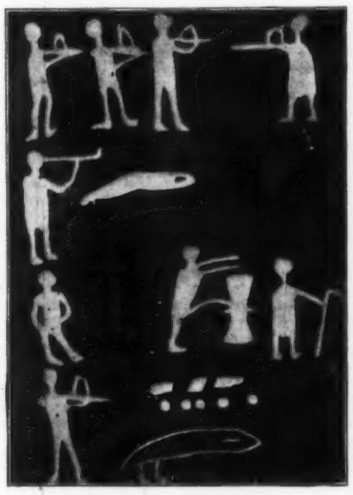
The venerable chief, Dito Mangue, who was our host for ten days at Ayenic, donned, on important occasions, an olive-green jacket, over which he draped a piece of tent canvas striped with blue and red. A Tyrolese hat, a mayor's scarf, and white breeches completed his gala attire; and the august monarch brandished in his right hand a small horse hair brush which served both as a scepter and an instrument for keeping away the flies. When we first reached the residence of this same Dito Mangue, in his village of Ayenic—a true type of the Pahouin village, with its cabins arranged on each side of the sole street, intersected by the "abene," or guard house—I greatly wondered at a long series of silhouettes drawn with chalk or charcoal upon the walls of the straw huts. These drawings, which were puerile, but of a movement that was sometimes quite correct, represented scenes of war, hunting and tom-toms, putting in action both warriors and animals. Aside from a few roughly carved heads designed for ornamenting the necks of parps, the Pahouins rarely represent the human figure.

Contrary to the custom of the Loangos, who keep fetich shops for the accommodation of travelers, and who improve their gods to the extent of almost making American dolls of them, the M'fan fetichists conceal their wooden divinities with great care. It might even prove dangerous for a foreigner to meet one of them face to face with a statue of Bieri, the all-powerful and jealous god that sometimes surmounts, in their huts, the round boxes in which are placed the venerated skulls of their ancestors.

While they are not very fond of manual labor, the Pahouins show themselves to be good artisans when occasion requires. They manufacture iron articles, forge weapons and carve wood with skill. These different kinds of work, more still than the silhouettes drawn upon the walls of their huts, tend to prove that the Pahouins are not entirely strangers to the culture of the fine arts. The form of their spears and sacrificial and hunting knives are wanting neither in elegance nor originality. The ornaments of their poniards and musical instruments slightly recall Egyptian art. Finally, in the decoration of their tom-toms, we find the traditional and hieratic lotus flower. These are so many valuable details for those who, like Schweinfurth, Father Trilles and several others, claim that the M'fans are natives of the basin of the Upper Nile and of the regions watered by the affluents of the Bahr-el-Gazal. Pahouin art is allied also to that of Arabia, and we are not permitted to conclude too affirmatively as to an influence exerted in former times upon the black people by Arab farmers of the revenue of the center of Africa.

As regards artichitecture, the Pahouins gives proof of a real and solid knowledge thereof. They are skillful builders, although after the manner of beavers. They construct their huts just as they did several centuries ago, neither better nor worse, after an invariable model: two rooms with one door and no window, walls of bark with double partitions; and over the whole a low rectangular roof composed either of the leaves of the palm or bundles of amomum and projecting over the front so as to form a pent-house. A dwelling of this kind can be built in two days with the use of nothing but a knife and axe. There is here a valuable advantage to the Pahouins. When, as a consequence of some child's play of doubtful propriety, or acts of violence, robbery or cannibalism, they see the soldiers of the militia sent against them by the French government in order to punish them by burning their village, they proceed in a fit of bad humor to fire a few shots or shoot a few arrows, then prudence warns them of the inutility of such efforts, and without delaying any further in the defense of their little cabins that are soon consumed by fire, they go philosophically to a remoter distance in order to build others.

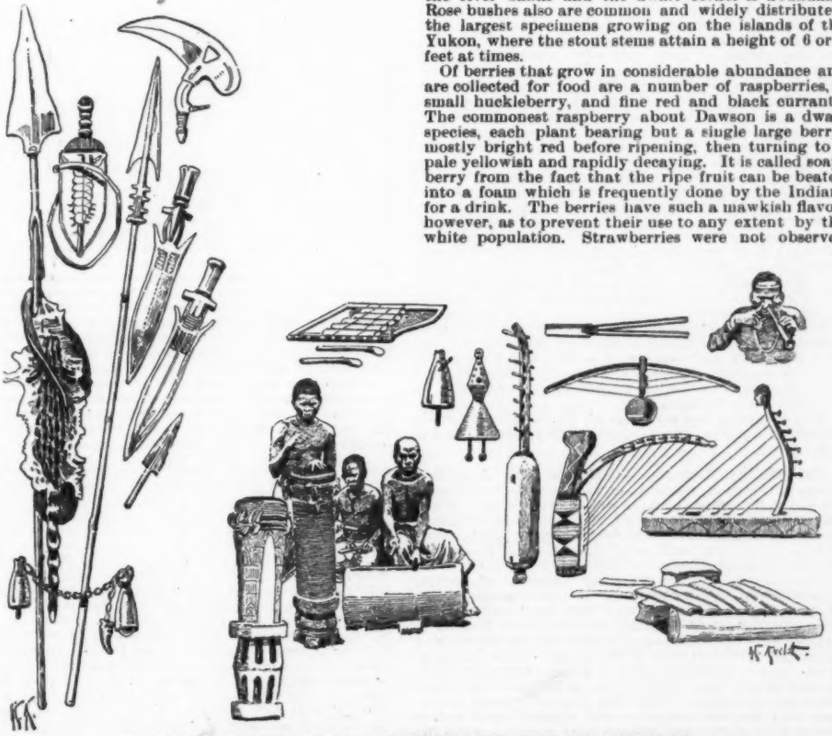
Despite the adage that music softens manners, it does not appear as if manners have changed much during the many years that the Pahouins (who dance) have been in Africa. The relative progress of the M'fans dwelling nearest the French posts is attributable to military parades and somewhat, too, to missionary influence rather than to the richness of the native orchestras. The musical instruments are quite varied. The blacks show themselves not only experts upon the drum, but, in their musical performances together are capable of using a combination of large and small bells, rattles, castanets, harps straight and curved, and finally, a sort of xylophone recalling the "balafo" of the



PAHOUIN DRAWINGS.

Soudanese. The natives of the Ogowe, in the vicinity of N'djole, Talagauga and Lambarene, likewise play on the nasal reed-pipe. This the musician introduces into one of his nostrils after taking care to stop up the other, and, by blowing, obtains sounds that are naturally nasal.

The word "tom-tom" designates the long African drums, hooped with ox or hippopotamus hide, and also the dances at which these instruments are employed. On the occasion of a festival, of a war, of the arrival of a white man, of a palavar, or of a marriage, the tom-tom players organize upon the public square of the village at nightfall. By the light of torches planted in the ground, which cast great copper reflections upon their naked bodies, the warriors leap about, howling like wild beasts. They tie huge streamers of dried grass around their arms, and fix to their legs a number of wooden balls that resound as they strike each other. Upon their heads are fixed eagle's feathers and top-knots of the touraco. And the women, girls and children draw mouthfuls of smoke from their pipes as they stand gazing at these superb demons stamping their feet amid the flames.—H. Avelot, in L'Illustration.



WEAPONS, MUSICAL INSTRUMENTS AND TOILET ARTICLES.

FOREST CONDITIONS IN THE KLONDIKE.

THE divide between the headwaters of the Yukon River and those flowing into Lynn Canal, known as the Chilcoot Pass, has an altitude of 3,500 feet. Lake Lindeman, one of the sources of the Yukon, situated 8½ miles from the Pass, is stated to have an altitude of 2,170 feet. At about one-third way down between the two, at about 3,000 feet, a forest vegetation first begins with a low, scrubby evergreen, growing in clumps here and there along the trial. Some small fir trees appear at the heads of the canyons and before Lindeman is reached trees up to 18 inches in diameter are found, although not abundantly. Rarely a spruce or two grows mixed in with the fir, and at Lindeman, pines, mostly in small groves without intermixture of other trees, are next in abundance to the fir. One or two small birches and alders, but not the paper or canoe birch so common down the river, and many willows are common in the swamps and wet ground about the lake. As one goes down stream the fir mostly disappears and is replaced by spruce. The paper birch begins to grow and the pine often becomes abundant, but seldom attains a size of more than 12 inches in diameter and a height of perhaps 50 feet. Below Five-finger Rapids, a distance of some 300 miles from Lindeman, no more pine was noticed. From there on down to Dawson the principal tree is spruce, together with considerable quantities of paper birch. Some cottonwood grows in the bottom land along streams. Scattering trees are found along the lower Klondike up to 15 or 18 inches in diameter and 50 or 60 feet high.

The finest spruce timber, says R. S. Williams in the Journal of the New York Botanical Garden, occurs on the islands of the Yukon, where saw logs up to 20 inches in diameter and 30 or 40 feet long can be obtained. The eight or ten sawmills, however, scattered along the river and at Dawson are rapidly diminishing the supply. During dry periods, also, which are apt to occur at any time between May and September, forest fires have destroyed many thousand acres of fine timber. Of paper birch, one of the finest growths observed is in the Klondike River bottom just at the mouth of Bonanza Creek, also extending up the latter some distance. The trees attain a height of some 30 or 40 feet and a diameter of 10 or 12 inches and furnish the best fuel to be found in the country.

Dawson, built on a low flat, sometimes partly overflowed by the river, has an elevation of some 1,500 feet, I believe, and the mountains in the immediate vicinity rise 1,500 or 2,000 feet higher. Spruce grows nearly to the summit of these low ranges but usually becomes quite well dwarfed near their tops. On the moister slopes are occasional thickets of alder and in dryer places, the trembling aspen, often in a stunted form, while on the dry exposed knolls, a small juniper is common. Looking eastward from one of these mountain tops near Dawson, the whole country to the main range of the Rocky Mountains, 60 or 75 miles away, seems quite well covered with timber, much of it, however, is undoubtedly very small, only an inch or two in diameter, and nowhere, apparently, is the timber or brush so thick as to prevent traveling through it quite readily with pack horses.

Of shrubby plants, outside of willows and small evergreen species of the heath family, there does not seem much variety to be noted. Buffalo-berry is common almost everywhere, but I did not observe it in either flower or fruit. A Viburnum is common and fruit-bearing also, and a small Juneberry, 15 or 18 inches high, was found in flower about the middle of June at Miles Canyon and about two months later specimens were collected at Dawson bearing hard greenish berries that probably seldom or never ripen in that latitude. A dogwood, 4 or 5 feet high is found occasionally along the river banks and the dwarf cornel is abundant. Rose bushes also are common and widely distributed, the largest specimens growing on the islands of the Yukon, where the stout stems attain a height of 6 or 8 feet at times.

Of berries that grow in considerable abundance and are collected for food are a number of raspberries, a small huckleberry, and fine red and black currants. The commonest raspberry about Dawson is a dwarf species, each plant bearing but a single large berry, mostly bright red before ripening, then turning to a pale yellowish and rapidly decaying. It is called soapberry from the fact that the ripe fruit can be beaten into a foam which is frequently done by the Indians for a drink. The berries have such a mawkish flavor, however, as to prevent their use to any extent by the white population. Strawberries were not observed

about Dawson, but along the upper river and down to near Five-finger Rapids the vines were not uncommon. I believe they never bear any great quantity of fruit.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Electric Street Railway in Geneva.—Within six months an electric street railway, projected by a citizen of San Francisco and constructed by an American electrical engineer, will be in operation in Geneva, says Consul Benj. H. Ridgely, of Geneva.

Some two and a half years ago, Mr. Henry E. Butters, of San Francisco, Cal., who has been connected with the construction and exploitation of street railways in Cape Town and the city of Mexico, was in Geneva. He found a congested population, badly served by old-fashioned steam tramways and horse cars, and the idea of securing control of the franchise of the principal companies and organizing a new company for the operation of a street railway system on the American plan at once occurred to him. The interest of local capitalists was enlisted, and in the course of some months Mr. Butters and his associates had secured a controlling interest in the Narrow-Gage Street Railway Company of Geneva, which owns and operates some 72 kilometers (44·74 miles) in the city and suburbs. The projectors also secured an option on the franchise and property of the Compagnie Générale des Tramways Suisses, which owns and operates 26 kilometers (16·56 miles) in the heart of the city and its environs. The price to be paid if the right under this option is exercised, as it doubtless will be, is 6,500,000 francs ($1,254,500). The projectors have also secured a federal charter under the title of "Compagnie Genevoise des Tramways Electriques" and obtained concessions to lay their tracks on some of the finest streets and quays of the city, including the famous Rue du Rhone and Quai des Bergues. They also secured the right to construct and operate a line on the famous lakeside drive from Geneva to Versoix, a distance of some 8¾ kilometers (5·44 miles), past the fine villas and chateaux of the wealthy and aristocratic classes.

The new company was organized with a capital of 5,000,000 francs ($965,000); but none of the stock has yet been issued or sold, although it has probably been largely apportioned. It is understood that the money for the construction is being furnished by the Paris Bank of South Africa. London capitalists are also interested in the venture, and it is likely that the new company in a short time will own and control all the street car-lines in the city and canton of Geneva. To put existing options into effect, to construct and equip all these lines on the American plan, and to exploit the extra exclusive rights of the new company will entail a total expenditure of about 15,000,000 francs ($2,895,000). The company would then have about 150 kilometers (95 miles) of road traversing the city in every direction and serving the entire canton. The total population amounts to about 119,000. The canton is next to the smallest of the Swiss Confederation and has only about 12 square miles of territory. The lines would also cross the frontier into France and would serve various small towns in the French Departments of Haute Savoie and Ain.

The engineer under whose management and direction the new lines are being constructed is Mr. Stephen D. Field, of New York and Boston. The work is progressing, and 15 kilometers (9 miles) of track have already been laid. One, at least, of the new lines will be in operation by the 1st of June. The American overhead-trolley system is being used, and the American system of conduits for underground cables, for the first time in Europe.

The charter of the new company requires that the materials used in construction be bought either from Swiss manufacturers or from Swiss houses representing foreign manufacturers. This for the moment virtually bars United States manufacturers, as no American concern has a Swiss agency. Up to this time, all rails have been bought in Germany, and all contracts for the construction of cars have been placed with Swiss agencies of German builders. The cars, however, are being built on the American plan, and one car has, by special permission, been shipped here from the manufactory of the Brill Company, in Philadelphia. France is largely furnishing the wire. The only American material that has yet been used is the Brown Edison plastic rail bond.

Although Geneva has a large water-power force for generating electricity, it is not believed that this plant will be able to furnish sufficient electric power for the new street railway. Mr. Field also thinks that the price asked by the city—12½ centimes (2¾ cents) per kilowatt hour—is unreasonably high. Electricity can probably be produced by steam in Geneva for from 6 to 8 centimes (1⅓ to 1⅔ cents) per kilowatt hour, and Mr. Field is willing to pay 8 centimes. The question is yet to be adjusted.

The tariff for street railway transportation in Geneva is fixed at 10 centimes (2 cents) per passenger for the first kilometer (five-eighths of a mile) and 5 centimes (1 cent) for each succeeding kilometer. Experts who have studied the situation do not doubt the profitable result of the enterprise.

The company has an office at No. 43 Threadneedle Street, in London, but its stock is not yet issued and is not for sale.

The English Language in Europe.—An American trade publication received at this consulate claims in its January number to have been advised that in some countries where it "expected other languages must of necessity be used in introducing American goods, English is altogether sufficient," says Consul Frank W. Mahin, of Reichenberg.

The phrase "some countries" means, of course, several countries at least, and so the average reader will understand that in any part of several foreign countries "English is altogether sufficient." This is true of only one European country—Great Britain and Ireland. It is not true of Germany, France, Austria, Italy, or any other continental nation. English is sufficient in only small parts of any of them—for instance, Dresden, Germany. That city contains many American and English residents and visitors, and nearly every shop keeper and professional person speaks the English language. There, probably, American goods could be successfully introduced with the use of English alone; but Dresden is exceptional. In nine-tenths of Germany, measuring by either population or area, poor success would reward attempts to do business with the English language alone. In Austria-Hungary, practically no business could be done with the use of nothing but English. The same applies generally to the other continental countries.

Every American consul on the continent is struggling to convince his countrymen who wish to build up an export trade that they cannot do it with circulars printed in English, which almost invariably go to fill waste baskets. The consul argues that circulars must be in the language of the country to which they are sent, and that if personal solicitation is used, the agent must fluently speak the language of the country in which he labors.

It is true that knowledge of the English language is spreading, and it is possible that in a generation or so it can be successfully used in doing business with any part of Europe. It is also true that some people in every town of considerable size have a smattering of English, but few of these people will take the trouble to read circulars printed in English. It takes too much effort. They talk a little, but will not bother to puzzle out the technical words in printed business matter, and the waste basket is made use of by them as well as by people who do not know a word of English.

While several tongues are spoken in Austria-Hungary, German is sufficient for business purposes and should be used by Americans seeking to build up a trade with this nation. They can accomplish nothing by adopting the theory that "English is altogether sufficient."

House-Lining Materials in Norway.—There have been two recent inventions in Scandinavia of materials that are adaptable for various purposes, but more particularly for lining houses. The names of these material are "Savareid Bygningspap" (Savareid building pasteboard) and "campo board," says Victor E. Nelson, Consul at Berger. The first, a Norwegian invention, is made from a specially prepared paper,* which, together with several layers of asphaltum, is compressed into a solid plate, thus forming a very serviceable and a fine material suitable for covering walls, ceilings, etc. The material thus obtained is absolutely damp proof and does not conduct heat; therefore, it will keep any room lined with it warm and comfortable. It serves to deaden noise and will keep away all kinds of vermin. Although a thick and solid substance, it is very pliable, and at the corners of a room can be either turned down or else bent to fit into the required angle without in any way destroying or injuring it. If used for paneling, it makes a smooth, even surface, free from cracks or folds of any kind. It is odorless and will not rot, and, although just as strong as a wooden panel, it will be found to be cheaper even than thin boards.

The other invention—"campo board"—Swedish patent, is a board composed of five layers. The central one is composed of pieces of wood fitting close together and lying in different directions. The adjoining layers are composed of very strong cement, which is used to fasten the pieces of wood forming the central layer into a solid and inseparable board. The two outer layers are composed of strata of very heavily compressed paper, which has been made waterproof. Campo board, as made in Sweden, in pieces 4 feet wide by 8 to 18 feet long, will be found as serviceable for the interior of houses as the building pasteboard, since it has the same qualities, and, in addition, can be used for lining ships, making boxes, trunks, all kinds of fillings, tables, writing desks, bottoms of drawers, signs, backs of looking-glasses, etc., and is capable of being either polished or painted. It would be found very useful by our trunk makers, as it is much lighter than ordinary wooden panels and is also cheaper. It should prove an excellent method of disposing of a large part of the odds and ends of wood which are to be found at wood-working factories.

Coal Famine in Europe.—The daily papers dilate upon the scarcity and extraordinarily high price of coal, coke and briquettes (blocks of pressed coal dust). To the increasing demands from industrial works in Germany, as well as in other countries of the continent, have been added the strikes in the coal mining districts of Bohemia, Saxony, Belgium, and France, says Vice-Consul-General Simon W. Hanauer, of Frankfort. The increasing scarcity has induced wholesale dealers to put their prices up so high as to cause violent protests from consumers, and the German coal syndicate of the Rhenish-Westphalian mining region has been compelled to issue a circular to the wholesale dealers in Western and Southern Germany who got their supplies from the syndicate. The circular says:

We receive every day well-founded complaints from consumers who have been old and faithful customers for our coal products, that they are charged preposterously high prices by wholesale dealers who get their coal from us. Others also complain that these dealers, with whom they have made contracts for certain quantities with price and delivery stipulations, create artificial difficulties in their execution of contracts or deliver smaller quantities. This syndicate requests that old consumers shall in all cases receive the quantities contracted for with you, and at no greater advance in price than is commensurate with the increased rate you pay us. We must further request you to stop the price extortions which are conducted through agents.

Coal Discovery in Quebec.—A mineral discovery which may lead to important results has been made in the Laurentian Mountains, says Felix S. S. Johnson, Commercial Agent of Stanbridge. This is the unearthing of a seam of coal on the land of the Shawinigan Water and Power Company.

Quite by accident, and while working upon excavations on the St. Maurice River, the find was made. The cuttings necessary to form the headrace are extensive, and in sections a depth of 125 feet has been reached, measured from the top of the cliffs above. It was while upon this work that traces of coal were found. The sand was discovered to be thickly impregnated with coal dust, which in some untold age had managed to break away from the present body and drift down. Later, in the work of excavating for the headrace, a seam of coal was stumbled upon. This was tried in the furnaces and found to burn well. The strata bearing the coal is some 40 or 50 feet below the surface, and its extent remains to be seen. It is thought, however, that the main coal body is located perhaps a mile up the river from the place where the present discoveries have been made.

In appearance, the coal has all the properties of the anthracite, and is not unlike the Pennsylvania article, the difference being that it has more polish and is far more brittle. Experts who have seen the specimens pronounce it not unlike some of the Nova Scotia product.

The surrounding formation is, of course, entirely different from that in the anthracite regions of Pennsylvania. The shale and slate which surround the coal measures of the Keystone State are entirely lacking. Geologists have always maintained that no minerals existed in the Laurentian Mountains, and that those granite hills contained nothing more valuable than the iron-like stone of which they were formed.

The secretary of the Shawinigan Water and Power Company has in his office a specimen of the coal taken from the edge of the seam. In this piece, the coal is found clinging to the granite rock, much as a bit of moss does to the ordinary bowlder.

Americans in Japan.—Consul-General Gowey sends from Yokohama, February 5, 1900, a copy of his reply to an inquiry from a resident of New York, relative to opportunities of employment in Japan. Inasmuch as Mr. Gowey has, he says, frequent occasion to communicate this information to parties in the United States, the letter is given below. It reads:

There are more young men here seeking clerical and official places than there are positions to be filled. Every issue of the English daily newspapers contains notices from young men seeking positions, many of them claiming experience in bookkeeping or the silk or curio trade, and the ability to speak and write French, German, etc.

There is no chance whatever to obtain positions under the Imperial government, for the tendency in official circles is to discharge foreigners as fast as practicable and fill their places with Japanese.

Every year finds an increasing number of young Japanese who have been educated abroad coming home and seeking positions, and it is, of course, the natural and inevitable thing that they should fill the places in their own government.

I would not recommend Americans to come to this country unless they have secured employment in advance.

Wheat and Rye Crops in France.—Consul Atwell, of Roubaix, under date of February 2, 1900, says:

The Minister of Agriculture has just published an estimate of the present condition of the crops of wheat and winter rye sown this year. This year's acreage of wheat covers a surface of 6,826,916 hectares (16,869,509 acres), against 6,919,400 hectares (17,097,837 acres) last year. It is estimated tnat the production will be 121,349,000 hectoliters (344,385,624 bushels), against 129,005,560 hectoliters (366,117,778 bushels) last year. The acreage of winter rye sown this year is 1,440,702 hectares (3,559,974 acres) last year, 1,478,150 hectares (3,652,509 acres). Present prospects indicate a production of 22,606,700 hectoliters (64,157,815 bushels), against 24,652,800 hectoliters (69,964,646 bushels) last year, a decrease of 1,446,100 hectoliters (3,573,313 bushels).

Demand for Coal and Iron in Brazil.—Minister Bryan writes from Petropolis, February 1, 1900, in confirmation of his cablegram of January 30, in regard to the demand for coal in Brazil. The President of the San Francisco Railroad, in the State of Bahia—Dr. Argolla—says Mr. Bryan, is inclined to make an experiment with 5,000 tons of bituminous coal, to be followed by further yearly orders if the trial proves satisfactory. Dr. Argolla, it seems, is a graduate of the Troy Polytechnic School and is desirous of promoting United States interests in Brazil. He thinks that structural iron for railroads and steel rails, if once introduced, would find an exclusive market. He therefore solicits catalogues and price lists of iron manufactures.

Japanese Emigration.—Consul-General Gowey, of Yokohama, January 25, 1900, sends a clipping from The Japanese Times of the same date, giving statistics relative to Japanese emigration. It appears that Japanese emigrants abroad at present are distributed as follows: In Hawaii, 40,000; in Australia, 4,000; in Canada, 4,000; and in Peru, 1,000. Besides these there are, of course, a large number of Japanese emigrants in China and Korea. There are twelve emigration establishments in Japan and two more in course of formation.

Demand for Railway Supplies in Russia.—Consul Halstead writes from Birmingham, February 19, 1900, that the London correspondent of the Birmingham Daily Post announces:

According to advices which have reached an official quarter here from St. Petersburg, tenders for the supply of two hundred locomotives and some thousands of goods trucks will be invited by the Russian government in the early spring. The locomotives are to be of unusually heavy make and great power, capable of drawing a load half as heavy again as that allowed for the engines already being employed on the completed sections of the Siberian Railroad.

* Pasteboard.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 687. March 26.—Early Closing in New South Wales—German Meat-Inspection Bill—International Plate-Glass Trust.

No. 688. March 27.—*Electric Street Railway in Geneva—Tiles and Mosaics in Venice—Tiles and Mosaics in Bohemia.

No. 689. March 28.—*Coal Discovery in Quebec—*The English Language in Europe—Antwerp Ivory Market—*Americans in Japan—*Wheat and Rye Crops in France—*Japanese Emigration.

No. 690. March 29.—Paraguayan Textile Plants—Cassareep in Paraguay—Soap Trust in Germany—Safety-Fuse Trust in Germany—*Demand for Coal and Iron in Brazil.

No. 691. March 30.—Shoes in Brazil—Beer Trade in Bahia—*Openings for Americans in Nicaragua—*American Wheat for Macaroni—*Import of Plants and Fruits into Cape Colony—*Ownership of Railroads in Nicaragua.

No. 692. March 31.—The Cultivation of Coffee in India—Americans in Korea—Linseed in the River Plata—*Machinery Exhibition at Christiania.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Treatment of Filtering Cloths.—As is well known, filtering and pressing bags are rather subject to spoilation unless very carefully treated. It is recommended to wash the bags and cloths immediately after each use and to keep them in a vat with clean water. A filtering cloth is similar to wood. If its state continually changes from wet to dry, it soon becomes brittle and entirely worthless. Bags and cloths which are kept wet, however, remain intact for a long time.—Neueste Erfindungen und Erfahrungen.

Solid petroleum can be prepared as follows: Household soap is dissolved in hot water and allowed to cool. Next, dissolve commercial aluminium sulphur in water and pour, with constant stirring, the aluminium solution to the soap solution whereby an exceedingly fine precipitate of aluminium oleate results. After washing and drying, an almost white power is obtained, which feels like talcum, and if 10 to 30 per cent. of petroleum is added to this with moderate heating, same remains in a solid state of vaseline-like consistency. Thus produced, it readily incorporates water, and is said to be excellent for impregnating leather, whose resisting strength it increases greatly.—Wiener Drogesten Zeitung.

New Process for Producing Calcium Carbide and Metals.—H. Aschermann has patented a process for the production of calcium carbide and metals, consisting in subjecting an oxide and a sulphide whose metals have different affinity to carbon, together with coal to the action of electric heat. If, for instance, a mixture of about the theoretical quantities of pyrites with lime and coke is treated in an ordinary electric furnace, on the one hand metallic iron is obtained, and on the other hand calcium carbide, which furnishes just as pure an acetylene as the calcium carbide produced in the customary manner, while the required current is at least 40 per cent. less, and, moreover, the furnace can be run continuously, since the mass may be readily cut off.—Neueste Erfindungen und Erfahrungen.

New Process for the Production of Potassium Cyanide.—A new process for producing potassium cyanide has been invented by Eduard Rieps, of Brunswick. According to same, powdered coal is mixed with alkaline carbonate and calcic hydrate as well as heavy hydro-carbons, molasses or similar mediums, and the mixture formed into thin-walled briquettes or hollow bricks, which are calcined for the removal of impurities.

By the addition of alkaline carbonate and calcic hydrate, the sulphates which might be present in the hollow bricks or briquettes are to be converted into insoluble calcic compounds or rendered soluble, whereby carbonic acid is expelled.

A current of ammonia is passed through the briquettes thus obtained at temporary, regular intervals, with continual supply of air. Same serves at the same time as a vehicle for the potassium carbonate to be supplied in dust form and required for the formation of the potassium cyanide, or for a mixture of ammoniacal salts and nitrates and carbonates of the alkaline metals, employed for the same purpose.

The supply of the powdery material may also be accomplished through an indifferent gas, in which case the ammonia is passed in separately.—Internationaler Pharmaceutisch-technischer Anzeiger.

Fine Toilet Soaps of French Origin.—For 50 kilos. of stock soap Savon à l'Ixora bréoni.

Violet powder	2500 grammes.
Cananga oil, Java	50 "
Tincture of musk	75 "
Cumarin, dissolved in spirit	15 "
Lavender oil	60 "
Peru balsam	125 "
Bergamot oil	60 "
Balm oil	50 "
Patchouly oil	12 "

Savon au Kadsura.

Violet powder	2500 grammes.
Heliotropin, in spirit	10 "
Cumarin, "	5 "
Peru balsam	50 "
Tincture of benzoin	350 "
Tincture of musk	75 "
Attar of roses	5 "
Bergamot oil	250 "
Lavender oil	75 "

Savon Theodora.

Lavender oil	30 grammes.
Clove oil	30 "
Thyme oil, white	80 "
Rosemary oil	80 "
Rose oil (attar of roses)	50 "
Tincture of benzoin	100 "
Tincture of musk	150 "

Savon au miel.

Citronella oil	150 grammes.
Cassia oil	120 "
Cedar wood oil	60 "
Balm oil	100 "
Sandal wood oil	50 "
Sassafras wood oil	50 "
Bergamot oil	60 "
Clove oil	20 "
Peppermint oil	10 "

Brisa de las Pampas.

Nerolin, crystal	15 grammes.
Cumarin, crystal	25 "
Heliotropin, crystal	75 "
Bergamot oil	200 "
Clove oil	75 "
Linaloa oil	150 "
Patchouly oil	25 "
Niobe oil	15 "
Tincture of musk	125 "

Savon ess. bouquet.

Geranium oil, Réun	350 grammes.
Bergamot oil	300 "
Niobe oil	50 "
Rose oil	5 "
Tincture of musk	200 "
Vanillin, in spirit	5 "

—Der Seifenfabrikant.

MISCELLANEOUS NOTES.

The wonderful development of the California fruit trade is further illustrated by the immense orange crop now being gathered in the southern part of that State. We read in a letter from Pomona that the yield of oranges this season is between 14,000 and 14,500 carloads, or from 4,200,000 to 4,500,000 boxes. There has never before been such a yield of oranges in California. Last year the crop was about 9,000 carloads, and the year before it was 8,000 carloads. The prices, too, are the best in ten years, and the present crop is worth to the growers about $4,600,000. The railroad companies will get about $2,600,000 for hauling the product to market, and the shippers, who are practically speculators in oranges, may make tens of thousands of dollars more from the output of the season. This industry is mainly confined to the southernmost counties of the State, and it is calculated that a capital of not less than $44,000,000 has been invested in orange groves there during the past ten or twelve years. The orange harvesting season begins in early December and continues until June.—Bradstreet's.

What the completed twentieth century will reveal is well set forth by Director W. R. Merriam in a contribution to a recent issue of The North American Review. Director Merriam's remarks apropos of the subject may be summed up in these words: "The census, taken at the dawn of the twentieth century, marks the greatest epoch in our national life. The age of iron has come to a climax with a force almost dynamic. The world has witnessed the golden age of Augustus, the silver age of Elizabeth, the era of great wars and of wonderful progress in the arts and sciences; but as the nineteenth century culminates, behold! the age of iron and steam and electricity, telegraphs, sewing machines, telephones, automobiles; an age which is devoted to material development, to the accumulation of wealth, and to the upbuilding of vast enterprises and which hails the advent of the uncrowned king of commerce, the consolidation of great corporate interests. High water mark in our commercial and industrial life has been attained, and to that fact the vast enumeration to be taken next year will add to its testimony. The work of the twelfth census will mark the industrial growth of the nation, and be another mile post in its mile post in its marvelous history."

Concerns sending out large quantities of mail matter every day have felt the need of some improved method of sealing envelopes, says The American Exporter. Here inventive genius saw its opportunity, resulting in the production of the automatic envelope sealer. With this machine 6,000 envelopes may be sealed in one hour. The unsealed envelope, containing its inclosure, is fed into one end of the machine, and it drops out at the other end into a hopper or the mail bag, ready to be carried to the post office. The machine is simple in its operation, and may be operated either by a treadle like a sewing machine or by an electric motor. If necessary, 100,000 envelopes could be sealed in a day by operating the machine sixteen hours with an electric motor. Insurance companies are now using this machine to mail their policies. Factories and concerns with a large pay-roll seal their pay envelopes with this new device. Through one of these machines passes the interest checks which are mailed by the Treasury of the United States by the hundreds of thousands a year, and through the United States pension agencies in various parts of the country hundreds of thousands of envelopes containing pension checks are sealed by these machines every quarter.

The present guns in use in South Africa are the—

Maxim, 0·303 caliber	600 per minute.
Colt, 0·303 "	400 "
Maxim, 37 mm. caliber	300 "

These have superseded the Gatling, Nordenfelt and Gardner guns, which were machine guns, but not automatic. The 0·303 Maxim is too well known to need any description, and the colt has been freely advertised of late, and is now undergoing its trials. It is a lighter gun than the Maxim, and when used with Lord Dundonald's light galloping carriage should have a use in the field; but we confess a leaning to the well-tried and trusted Maxim, so long as the ammunition is high class. The new 37 mm. has given us a bitter taste of its powers at Spion Kop, where it poured out its 1-pounder shell at the rate of 300 per minute. Fortunately there were only 25 rounds in a belt, so it gives a few seconds interval till the next belt is fixed. I trust we may soon have our guns out there, with plenty of ammunition, for they are very veracious. The limbers on the field carriages for these guns carry 12 belts, and these could be fired in under two minutes; it is essentially a "now or never" emergency weapon.—Arms and Explosives.

C. G. Hopkins employs the ordinary incandescent lamp in extraction work and finds it preferable to the gas flame for use in ether extraction, not only on account of its safety, but also because of its greater simplicity, constancy, cleanliness, and convenience. For a set of twenty complete sets of Soxhlet extraction apparatus, five 110 volt lamps, of thirty-two candle-power each, are placed in the air-bath, and they are found sufficient to produce a distillate amounting to about 60 drops per minute in each apparatus. The air-bath employed is a galvanized iron box, thirty-six inches long, eight inches wide, and six inches deep, with double side walls and triple end walls, leaving half inch spaces in which are placed strips of asbestos paper to decrease the loss of heat by radiation. The board upon which the bath stands is also covered with asbestos. The removable cover of the bath contains twenty holes arranged in two rows. The holes are two inches in diameter, and their centers are three and a half inches apart. The lamps are placed seven inches apart, one under the middle point of the square formed by every four holes. This symmetrical arrangement and the precaution taken to decrease radiation at the ends of the bath should provide practically the same amount of heat for each set of extraction apparatus. With the extraction in operation the temperature of the cover of the bath does not exceed 75° C., but with all the holes covered it is possible to raise the temperature to a point at which ether vapor will ignite. If, therefore, it be desired to assure absolute safety a water-bath should be employed, the bulb of each lamp being immersed in the water.—Journ. Am. Chem. Soc., 21, 645.

BRINTON MEMORIAL CHAIR IN THE UNIVERSITY OF PENNSYLVANIA.

SCHOLARS the world over are appreciative of the achievements of the late Daniel Garrison Brinton, for he established on a firm basis the branches of learning to which he devoted his life. He is justly named the "Founder of American Anthropology."

A close student of the intricate problems of his science, he possessed the rare art of clearly and concisely presenting facts at their true values. He believed in "the general inculcation of the love of truth, scientific, verifiable truth," and that knowledge should subserve usefulness.

A keen observer, a classical scholar, an adept in the methods of logic and philosophy, Dr. Brinton had ever the practical application of truth in view. To the systematic study of man he brought to bear his all-rounded culture to further the happiness and fullness of the individual life. He regarded the individual as the starting point and goal of anthropology. Upon individual improvement, he claimed, depended group or racial improvement, social amelioration, and the welfare of humanity.

Anthropology, the new science of man, in Dr. Brinton's own words, "is the study of the whole of man, his psychical as well as his physical nature, and the products of all his activities, whether in the past or the present."

This broad comprehension indicates the significance of anthropological study. Its limits of attainment are limited only by the nature of man himself, and Dr. Brinton asks, "Who dares set a limit to that?"

Although the youngest of the modern sciences, anthropology is none the less one of the most important of the sciences, for in its development is bound closely the progress of society. To carry out the aims of anthropology, are required the results obtained from the study of ethnography, ethnology, psychology, folk-lore and archæology,—more especially prehistoric archæology, which concerns itself not only with the ancient but with "the simplest" and "most transparent and therefore the most instructive."

Notwithstanding the extension of this work in America, comparatively few professorships of anthropology or its branches exist, and the limited opportunity afforded students to qualify themselves for investigation in these various subjects is manifest. Dr. Brinton pointed out the insufficiency of facilities for students to acquire the necessary preliminary training to fit them for research, and he advocated and urged that anthropology should be studied generally in our colleges. Provost Harrison referred to this in his address at the Brinton Memorial Meeting held in Philadelphia January last, and stated that Dr. Brinton had the utmost confidence in anthropology as a science and also in its practical worth as an applied science in politics, education and legislation.

It is proposed in recognition of the great services he rendered to the world by his teachings, numerous publications, and untiring zeal in unearthing the false and proclaiming the true, to establish in his memory a Brinton chair of American Archæology and Ethnology in the University of Pennsylvania.

THE MEERSCHAUM PIPE CENTENARY.

AN innocent mania of the present time in France is to celebrate all manner of anniversaries. A little while since a great deal was written in French about the centenary of the high hat of the "chimney pot" type, but a topic of later interest was the centenary of the meerschaum pipe. It was just about one hundred years ago that the strange substance in nature called meerschaum by the English (in imitation of the Germans), and écume by the French was first employed in pipe making. The French word is simply a translation of the German one meaning sea foam, and it was originally written in full, écume de mer. It is no secret nowadays that the substance is pure silicate of magnesia, but the absurd notion that it was petrified sea foam was long clung to by the public with remarkable pertinacity. There can be little doubt that the Austrians and other Germans who were the first to apply it to pipe making did nothing to destroy the fable concerning its origin. It was their interest to make it appear extremely rare and to surround its nature with mystery. As a matter of fact, silicate of magnesia is only found in a very few places and in very small quantities in Europe, the most favored regions being Moravia and the Crimea. Therefore, meerschaum pipes were extremely costly until it was discovered that the much-desired mineral lay in extensive beds under alluvial soil in Asia Minor. Fifty years ago—the manufacture of meerschaum pipes having then been recently taken up by the French—M. Cardon, an enterprising Paris tradesman, determined to obtain the material first hand, started off on a voyage of discovery to Asia Minor. He was captured by brigands and went through other stirring adventures, which he afterward related in a very amusing book; but he carried out his object. He not only brought back a large quantity of meerschaum, but established such relations in the country that he could rely upon obtaining a constant supply. Thus it was that the Parisians became formidable rivals of the Viennese in the manufacture of artistic meerschaum pipes—an industry perfectly adapted to their fanciful genius. It may be mentioned that freshly dug meerschaum is quite soft and possesses the properties of soap, as a substitute for which it is sometimes used by the Turks.—Leisure Hour.

Packing Hams for the Singapore Market.—Consul-General Moseley writes from Singapore, under date of January 3, 1900:

A letter which I have received from W. A. Wafford & Company, of this city, who recently imported from the United States ham, bacon, and lard, contains the statement that "small hams on arrival here turned out bad, owing to the very inefficient method of packing." As soon as I learned this, I requested a large local dealer in English and Scotch hams to tell me how these hams are packed, and in reply he says:

Hams are generally sent here packed in bran or oats, then sewed in canvas, and afterward packed in salt, this process preserving the flavor far better than any other method, besides keeping the ham moist. The usual weights for Singapore are from 8 to 12 pounds.

PHOTOGRAPHIC NOVELTIES.

THE "Pascal," an automatic photographic apparatus. We must, in the first place, inform our readers that by the word "automatic" we do not mean to say that a positive drops into the hand of the operator ready printed, toned, and fixed, although a step has been made toward such a result, which we must not despair of seeing reached some day or other. In realty cameras have been constructed in which the changing of the plates is done automatically, and a system of this kind has been described in these pages; but, up to the present, the result of work in this direction has been a complication that has placed the apparatus at a high price.

In the Pascal apparatus under consideration there are no glass plates used, but instead of them a spool of sensitized film. After this has been put in place, all that has to be done in order to take a photograph

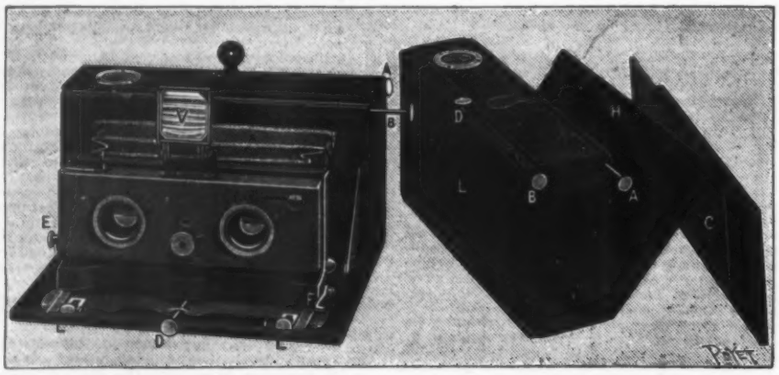


FIG. 1.—THE "STEREO-POCHETTE," A POCKET PHOTOGRAPHIC APPARATUS.

is to push a button. The operation may be repeated twelve times in succession, as rapidly as may be desired. After this, all that is done is to change the spool, an operation that can be performed in broad daylight. The number of negatives is limited only by that of the spools on hand. The dimensions of the apparatus are $7 \times 8 \times 11$ centimeters, and those of the images, $4 \times 5\frac{1}{2}$.

Let us now see how the apparatus works. We remark in the first place that the spool that is to be put in place is provided at one of its ends with a round aperture and at the other with a square one. This latter is designed for the reception of a spindle of square section, which forms the extremity of the axis of a barrel, *D*, containing a spring (Fig. 2). The spool, once in place, will serve as a key for winding up the spring. How this is done will be described further along.

The sensitized strip is prolonged by black paper, and it is, consequently, possible to begin the unwinding in broad daylight. The operator grasps the extremity, *O*, of the strip, in which there is a metallic eyelet that that is placed upon a hook carried by the drum, *N*. In its passage from the spool to the drum, the strip runs over rollers that limit the section exposed and hold it level opposite the objective, *A*. The apparatus is then closed. On the exterior is observed a ring. This is the extremity of the axis of the drum, *N*. Upon

FIG. 2.—THE "PASCAL," AN AUTOMATIC PHOTOGRAPHIC APPARATUS.

revolving it, the film is wound around the latter, and the spool is, consequently, revolved and completely winds up the spring of the barrel, *D*. The operation is watched from the exterior by means of a dial, *C*. A register pin shows when it is necessary to cease to turn, that is to say, when the entire length of the film has left the spool. Everything is then ready for operating. When the button, *H*, is pressed, an anchor escapement, *B*, allows a small portion of the spring to expand, so as to bring about a motion of the wheel, *M*. This latter is provided with a cam, which, through the levers, *E* and *F*, actuates the shutter, *G*, an internal view of which is shown in the engraving. The levers, *K* and *L*, are connected with the exterior through an axis ending in a hand that stops opposite the letters, *I*, *R*, *P*, which designates the positions in which are obtained instantaneous, slow, or rapid exposures at will.

When the operator's finger releases the button, *H*, the anchor escapement, *B*, is freed, and the drum makes an entire revolution in allowing just enough of the strip to unwind to replace, opposite the lens, the part that has just been utilized, and that is wound around the spool.

After each pressure upon the button, *H*, the register of the dial, *C*, marks one division, and a figure placed opposite gives the number of unexposed spaces that remain utilizable. When zero is reached, the entire strip has been impressed and replaced upon the spool, protected by its black paper. There is then nothing to be done but to open the apparatus, take out the spool and replace it by another.

Upon the whole, the mechanism is very ingenious, and permits, as we have said, of reducing, to the mere push of a button, the impression of the portion of the strip exposed, and of replacing it by a new portion. The result is that we have here almost a cinematograph, since, in fact, it is possible to make the twelve consecutive exposures in less than ten seconds, although this is not to be recommended. Generally speaking, it would be better to take each picture in due course, and with the period of exposure required by it.

The "Stereo-Pochette."—We now pass from complicated mechanism to the absence of all mechanism. In fact, the Stereo-Pochette has no other pretention than that of occupying but very little space and of being able to be carried in the pocket. The metallic frames used in it are small and scarcely thicker than the sensitized plates, and are placed in different pockets. Their number is not limited.

The apparatus, when closed, is but 4 centimeters in thickness, 8 centimeters in width, and 16 in length. The buttons, *A*, *B* and *D*, the two first of which serve for opening and the third for focusing, do not exceed, but just come on a level with the morocco covering. The whole affair has the aspect of a thickish pocket-compass. Upon drawing the bolt, *B*, the operator opens the front, *L*, which then forms a right angle with the rest of the box. He then draws out the board that carries the lens and that slides out to a stop, where it remains fixed. It is held in this position by depressing a small lever, *F*. If it be desired to focus, a pressure is made upon a button, *D*, which moves the small carriage upon which the board slides. A ground glass may be employed in this case, but if it be desired to avoid the use of it, a scale graduated in advance for distances of from 1 to 6 meters may be employed.

The shutter, which is set by means of a button, *E*, gives the exposure and instantaneousness at different speeds. The iris diaphragms are maneuvered together through a single button. The frames are placed at the back of the apparatus, which drops, like the front, when a bolt, *A*, is withdrawn. After they have been inverted, the door, *H*, is closed upon them, the slide, *C*, is removed, and the apparatus is ready to operate. The finder, *V*, which consists of a concave lens fixed upon the front, is put in place automatically when the apparatus is opened. The board that carries the lens can be easily raised. This is an important feature that does not generally exist in small apparatus. Despite its reduced dimensions, the stereo-pochette gives negatives upon a single 6×13 centimeter plate, these being nearly the normal dimensions of ordinary stereoscopic views. In fact, there are obtained upon this plate two negatives, 6 centimeters square. The spacing of the eyes does not permit of observing images more than 7 centimeters square, which, moreover, is the regular size. For stereoscopic photography, the size of the plates generally used is 9×18 centimeters. We ask why this should be so, since, in printing positives, it is necessary either to operate by reduction by camera, or else, if we operate by contact, to cut off a part of the image which is lost. Upon the whole, we think that this 6×13 centimeter size is very well selected, and the more so in that, that though we find plates of this size in the market, it would be very easy for a person to cut them himself from 13×18 plates, of which they are exactly a third of the size, and that are to be found every every.

For the foregoing particulars and the engravings, we are indebted to La Nature.

NEW FIREPROOF MATERIAL IN GERMANY.

THE United States Consul at Freiburg calls attention, in a recent report to his government, to a new industry which has lately been introduced into that city, and which promises to be a great commercial success. The business pertains to the treatment of cottons, linens, woolen goods, etc., or any article of fibrous or textile nature, by a chemical process which renders such articles fireproof. By the new method, the goods that are to be rendered fireproof are treated chemically by a very quick process which does not act on the fiber, so the goods lose nothing in strength, nor does the treatment in any way affect the color or perceptibly increase the weight, and the advance in the price of the article is very slight. Consul Liefeld states that he procured some samples, and tried a few experiments with cloth which had been made fireproof by the new process, and found that no flame or fire is produced, as was the case with similar articles which had not been so treated. Only where the candle flame came into direct contact with the cloth was the fiber charred, but there was no spread of fire, and as soon as the flame was removed the charring ceased. He poured some kerosene oil on a piece of the cloth and ignited it; the oil burned vigorously, but the cloth was simply charred where it had been soaked with oil, and there was no spread of fire. A piece of wood wrapped in a piece of fireproof canvas was placed for a few moments on the red-hot anthracite coals of a furnace, and when examined was found to be uninjured, except where it had been in direct contact with the coal. It would seem from these experiments that such a fireproof article would be serviceable for the storing or packing of explosives. There is one disadvantage connected with this discovery which prevents the use of these fireproof articles for out-door purposes, viz., that water can dissolve the chemicals, and then the substance is no longer fireproof; but, as such material can be washed, and then reimpregnated very easily and cheaply, and so again rendered incombustible, it would seem that this does not greatly depreciate its value. Steam and moisture do not affect the fireproof qualities, nor does the application of heat. It is also claimed that the manufactured article is not in the least poisonous. It is stated that the increase in price to the consumer of the fireproof article need not be more than three halfpence the square yard over that of the unimpregnated, and in large quantities the difference would be even less, while the increase in weight would be only about one pound for every fifty square yards of material.

CHEMICAL MANURES APPLIED TO FRUIT TREES.

IN proportion as the great utility and certain efficacy of chemical manures has been demonstrated, cultivation has been more and more systematized. The means which they furnish for almost complete renovation, not afforded by barnyard manures, has been recognized; yet our cultivators may err in neglecting the latter on account of the difficult transportation and trouble of handling, as these make valuable material for the production of humus, for which chemical manures are not suitable.

We wish to call attention especially to the application of chemical manures to fruit trees.

The Germans have outstripped us in the study of this question. It is a dozen years since they commenced the preparation of experimental orchards, says Le Phosphate, in which, as M. Grandeau reports, they have systematically employed the principal commercial manures. The German chemists first ascertained the quantities of the nutritive principles abstracted by the trees annually from the soil for the formation of their wood, leaves and fruits. Thus, an apple tree, a pear tree, a plum tree, or a cherry tree, of a diameter of 25 centimeters, it was found extracts from the soil per square meter of the surface under its leafage, which corresponds nearly to the extent of its roots, the following quantities are the four principal materials of its alimentation:

Nitrogen	17	grammes.
Phosphoric acid	5	"
Potash	22	"
Lime	40	"

These are the minimum quantities of the principles utilized in the ordinary growth of a tree of 25 centimeters in diameter for the production of its wood, saves and fruit.

This first point being established, it was next important to ascertain what the soil contains. For it would be useless to apply, for example, potash to a clayey soil containing sufficient for a long succession of harvests; or lime to another soil which might be already largely supplied with it; and the same would be true, although the properties are less, of phosphoric acid and nitrogen.

Here, then, is where the chemical analysis of the soil must intervene in order to ascertain the renovation to be effected, keeping in view all the while the space occupied by the roots corresponding to the leafage.

We admit, according to the example cited by M. Grandeau, that out of a hectare of orchard it will be only the quarter covered by the development of the branches or, in other words, the quarter occupied by the roots (about 2,500 square meters) that will need to be enriched with chemical manures. Resuming the figures cited before, it appears that the annual quantities demanded by the trees are as follows:

	Grammes.	Kilos.
Nitrogen	17 × 2,500 =	42·5
Phosphoric acid	5 × 2,500 =	12·5
Potash	22 × 2,500 =	55·0
Lime	40 × 2,500 =	100·0

The above figures correspond to the following weights of the different commercial manures:

Sodium nitrate	270 kilos.
Ammonium sulphate	216 "
Wool or terrefied horn	300 to 380 "
Débris of dephosphoration (superphosphate)	150 "
Potassium chloride	110 "
Kainite	400 "

M. Grandeau remarks that in most soils the above quantities of nitrogenized manures should rarely be exceeded, if even reached; that the case is otherwise with phosphatic manures, considering the general poverty of lands in phosphoric acid. As a source of phosphoric acid he recommends the débris of dephosphoration which will supply both phosphoric acid and a little more than half its weight of lime. As to potash, the quantities of potassium chloride and kainite may vary a good deal, according as the soil is calcareous, silicious or argillaceous.

THE VEDOVELLI AND PRIESTLEY CAB.

THE interest of the Vedovelli and Priestley cab resides both in the method of steering it and the form of the body, which, through a simple maneuvering of the apron, permits of obtaining a vehicle to accommodate two or four persons. The body is mounted upon a tricycle, the front wheel of which, of very small size, supports but a small portion of the total weight, and moves loosely upon a vertical axis which is not in a line with the horizontal one, as in the case of furniture casters. It thus always instantaneously adjusts itself to the direction assumed by the carriage when it is steered. The hind wheels, which are of larger size, are both driving and steering ones. A special mechanism that we are about to describe causes them to revolve at identically the same angular velocity for steering the vehicle in a straight line, and gives them different speeds on curves. The carriage then turns in the direction of the wheel that has the least speed.

In order to obtain such a result, each of the two wheels is actuated by a special electric motor, with a reduction of speed by belt and gearings, and the two wheels are rendered interdependent by a mechanism of which the principle is shown in Fig. 2.

Here, R_1 and R_2 are the two wheels, and $a\,b$ and $a'b'$, are the two sections of the axle in the same line with each other. At each extremity, and parallel with each other, are mounted, two hollow gearings, R_3 and R_4, in the interior of which are mounted two other gearings. The first of these, r and r', are concentric with the gearings, R_3 and R_4, while the others, p and p', connect on the one hand the gearing, R_3, with the gearing, r, and, on the other, the gearing, R_4, with the gearing, r'.

The two gearings, r and r', are connected mechanically and always revolve together.

The gearing, p, is carried by an axis connected with a bevel wheel, q, of which the axis is the same as the general axis of the system, $x\,y$. The gearing, p', too, is carried by an axis which is connected with a bevel wheel, q', the axis of which is the same as the general axis of the system, $x\,y$. The axes of the gearings, p and p', are therefore capable of shifting and of revolving around the axis, $x\,y$, while remaining parallel therewith.

The bevel wheels, q and q', are connected with each other by a gearing, s, controlled by a hand wheel, V.

If the hand wheel, V, be revolved, the gearing, q, will be made to revolve in one direction, and the gearing, q', in the other; and the gearings, p and p', will be revolved at the same time.

Let us now examine the operation of the system. If we give the wheel, R_1, a rotary motion in one direction or the other, such motion will be transmitted to the hollow gearing, R_3, which causing the pinion, p, to revolve, will actuate the gear wheels, r and r'. The gear wheel, r', will cause the revolution of the pinion, p', which, in turn, will revolve the hollow gearing, R_4, and the latter will actuate the wheel, R_2. It will be seen, then, that if the hand wheel, V, be immovable, the two wheels, R_1 and R_2 will revolve the same speed.

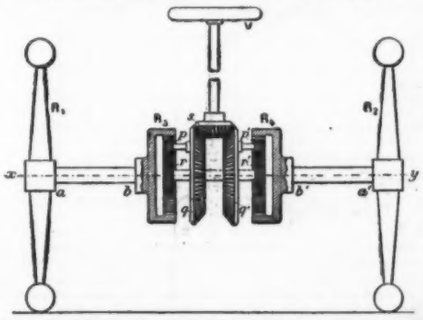


FIG. 2.—METHOD OF STEERING THROUGH THE VELOCITY OF A VARIABLE WHEEL.

Let us now suppose that the two wheels, R_1 and R_2, are not influenced, and that the hand wheel, V, is made to revolve in one direction or the other, from right to left, for example: Then the gearing, p, will revolve in one direction around the axis, $x\,y$, and the gearing, p', will revolve in a contrary direction around the same axis. The two toothed wheels, r and r', will, therefore, be influenced by two forces that are equal and of contrary direction; and, since they are interdependent, these two wheels will remain immovable. But, as a consequence of its rotary motion around the axis, $x\,y$, and of the immobility of the toothed wheel, r, the pinion, p, in its displacement, will revolve upon itself and force the hollow gearing, R_3, to revolve. The same will be the case with the pinion, p', which will cause the gearing, R_4, to revolve. But the revolutions of the gearings, R_3 and R_4, take place in an opposite direction. The wheels, R_1 and R_2, of the vehicle will participate in the motions of the gearings, R_3 and R_4, and, consequently, since one revolves in one direction and the other in a contrary one, the vehicle will turn in situ.

If now, we give the wheels of the vehicle a proper motion, the reaction of the gearings, R_3 and R_4, will, through the intermedium of the pinions, p and p', revolve the two toothed wheels, r and r', which were immovable; and if, during the revolution of the wheels, R_1 and R_2, we revolve the hand wheel, V, one wheel will revolve faster than the other, and consequently permit of steering the vehicle through an action upon the hand wheel in one direction or the other.

Experiment alone will be able to teach us the practical value of this arrangement, of which the novelty and originality cannot be disputed. For the foregoing particulars and the illustrations, we are indebted to L'Industrie Electrique.

FIG. 1.—THE VEDOVELLI AND PRIESTLEY CAB.

THE RELATION BETWEEN THE PERIODIC CHANGES OF SOLAR ACTIVITY AND THE EARTH'S MOTION.

ONE of the most interesting questions arising from the problem of the sun's activity is that of a possible connection between the varying display of forces on the solar surface and certain phenomena on our planet. The evidence which has been gradually accumulating can hardly fail to convince us of the existence of an intimate, though still mysterious, relation between some of the manifestations of the earth's magnetic forces and the state of dynamic action on the sun. Not only the extraordinary coincidences repeatedly recorded between solar eruptions and terrestrial magnetic storms, but still more the striking synchronism between the varying frequency of solar spots and the observed changes in the display of auroræ, and in the daily oscillations of the magnetic needle clearly point to that conclusion. Scarcely less certain seems to be the fact, confirmed by many recent investigations, that a greater or less disturbance of the sun's surface is attended by corresponding effects upon terrestrial temperature, rainfall, and other meteorological phenomena.

But there appears to me to be good reason for believing that the influence of the solar activity upon our planet is of an even more profound and far-reaching nature than has hitherto been imagined. I shall endeavor here to state as briefly as possible the results of investigations (more fully developed in Astr. Nachr. No. 3,619) which have led me to conclude that the period of solar activity can be distinctly traced in the minute residuals which it has not hitherto been possible to eliminate from the observed values of the earth's elements. We are thereby led to infer that the same unknown force which apparently plays so important a part in the meteorology of the sun, acts upon the motion of the earth to such a degree as to produce perturbations which, though minute, are yet of considerable importance from a theoretical and even practical point of view.

As regards the variation of the spot-phenomenon, all the material here required could be taken from Wolf's Astronomische Mittheilungen. The chief results which we owe to the never-tiring zeal of this eminent astronomer, and to his intense devotion to this particular branch of astronomical science, are too well known to require, for our present purpose, more than the remark that there are two well defined periods in the spot development, the shorter embracing, on an average, about eleven years, and the longer covering, in Wolf's opinion, nearly six times that interval. These two periods are equally important for the following investigation, the curves of the residuals showing the influence of the greater cycle not less distinctly than that of the shorter one. To mention some of the principal features of the "great" spot period—this being probably less familiar to men of science than the eleven years' cycle—it may be stated that this curve rises from a minimum near the middle of last century to a high maximum in 1788, then rapidly descends to a low minimum in 1816, attains subsequently another high maximum in 1838, descends again to a moderate minimum in 1861, rises to a small maximum about 1873, and eventually falls to a low minimum in 1888, from which it has since been steadily proceeding to higher values, so that another maximum may be expected in the near future.

Now, to prove our assertion as to a connection between the periodic changes of solar activity and the motion of our planet, we shall, in the first place, consider the changes in the mean obliquity as observed at Greenwich from Bradley's time up to 1896. If, besides the gravitational effects produced by sun, moon and planets, no other perturbing force were acting on the earth-spheroid, the observed values of the mean obliquity should be found to decrease uniformly with the time, this "secular variation" being due to the perturbations produced by the planets. The measured arcs of the obliquity would then be very nearly represented by Leverrier's formula:

$$\varepsilon = \varepsilon_{1850} - 0''{\cdot}47594\,(t - 1850).$$

Owing to the uncertainty of the values of the masses adopted for some of the perturbing planets, the numerical factor in this equation may have a somewhat different value. But the differences between the observed arcs of the obliquity and the values derived from Leverrier's equation ought in any case to be found to increase or decrease uniformly with time. This, however, is far from being the case, as may be readily seen from the accompanying diagram, in which the abscissæ are represented by the epochs of observation, and the ordinates by the differences observed obliquity minus Leverrier. The data from 1757 up to 1812 are taken from Prof. Newcomb's treatise, "Elements of the Four Inner Planets, etc., Washington, 1895." Since 1812, the data are deduced directly from the annual Greenwich observations. In order to eliminate any possible influence of the shorter sun-spot cycle, which shall be investigated separately later on, these annual values are combined into groups comprising twelve years of observation. This method enables us to study the waves of long period by themselves, independently of the shorter cycle.

Here, then, it will at once be seen that the observed changes in the mean obliquity cannot be represented by a linear function of the time, but that, besides the secular term, they show three distinct relative maxima and minima. Now, the remarkable feature about these turning points is that their positions agree almost absolutely with those exhibited in the "great" sun-spot period. The two high maxima about 1780 and 1840, as well as the very low minimum in 1815, nay even the less pronounced oscillations indicated by the curves of solar spots, are also most clearly recognizable in the curve of the obliquity represented in Fig. 1. In view of so remarkable a coincidence, the observed changes in the obliquity may be closely represented by the introduction into Leverrier's formula of a term depending on the great sunspot period. If this term, after being evaluated for all the epochs of observation, is subsequently subtracted from the single values of $\delta\varepsilon$, in Fig. 1, the following curve is obtained:

Now, uniform increase or decrease with time implies that the values of the obliquity should be grouped approximately along a straight line. While this was by no means the case in Fig. 1, it is perfectly true of Fig. 2; and thus it is clear that, taking into account the additional perturbing force due to solar activity, the observed values of the mean obliquity are brought into entire agreement with the deductions of planetary theory.

The significance of the result just obtained is considerably enhanced by the remarkable fact that exactly the same peculiarities appear in the variations of all

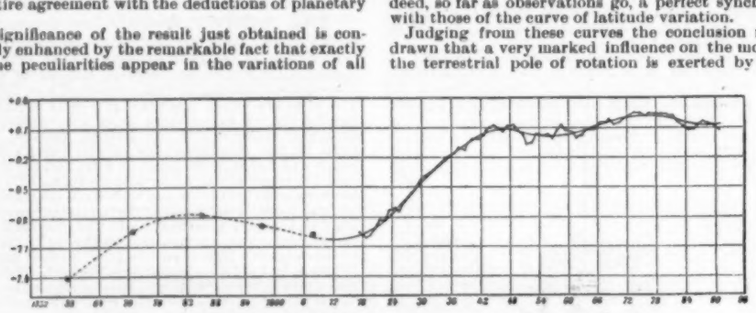


FIG. 1.—CURVE OF OBLIQUITY. (From the Astron. Nachr. 3619.)

the other elements of our planet as in those of the obliquity. Not one of the elements, as deduced from observation, can be rigorously represented by a secular term alone; they all show in addition well marked periodic fluctuations closely agreeing with those of the "great" spot period. The reality of a distinct, if minute, influence exerted by the changes of solar activity on the earth's motion cannot, therefore, be doubted, though we are as yet completely in the dark as to the physical causes of this peculiar perturbation.

Now, the question arises as to whether traces cannot be discovered of a similar influence upon the motion of the earth-spheroid synchronous with the eleven years' cycle of solar activity. The result obtained on this point receives additional importance from the fact that it throws quite a new light on the theory of a peculiar

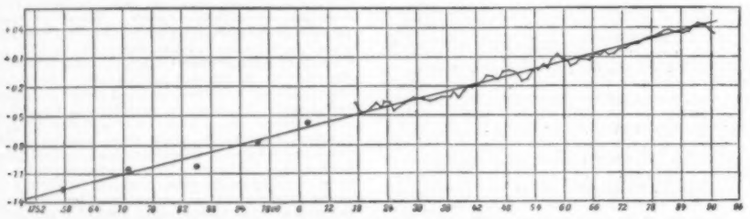


FIG. 2.—CORRECTED CURVE OF OBLIQUITY. (From the Astron. Nachr. 3619.)

phenomenon, which has now greatly attracted the attention of astronomers, viz., the variation of latitude. The conclusion to be drawn from our investigation points to a close relationship between the amplitude of the motion of the terrestrial pole and the period of solar activity. It may be taken to be clearly established that the radius of the circle described by the pole of instantaneous rotation is greatest at times of sun-spot minima, and smallest at times of maximum displays of solar spots. This correspondence is found to hold true for the whole interval of about sixty years now covered by Dr. Chandler's investigations. The subjoined diagram may help to give a clear idea of this peculiar relation, the first curve showing the semi-amplitudes of the latitude variation for every year from 1856 to 1898, as deducted from Chandler's curves in Astron.

On the whole, then, we are confronted by the fact, so distinctly brought out by observation, that the motion of our planet reveals traces of the action of a force, the intensity of which can be measured by the state of activity on the solar surface. No doubt, the perturbations caused by this force are extremely minute as compared with the gravitational effects exerted on the earth-spheroid. But still, in the present state of our theoretical knowledge regarding planetary motion, and with the high degree of perfection now attained in the art of astronomical observation, such minute quantities are of considerable importance. This is, for instance, sufficiently illustrated by the derivation of the solar parallax from the secular variations of the obliquity and the node of Venus. The value for this constant, as found after eliminating the perturbing

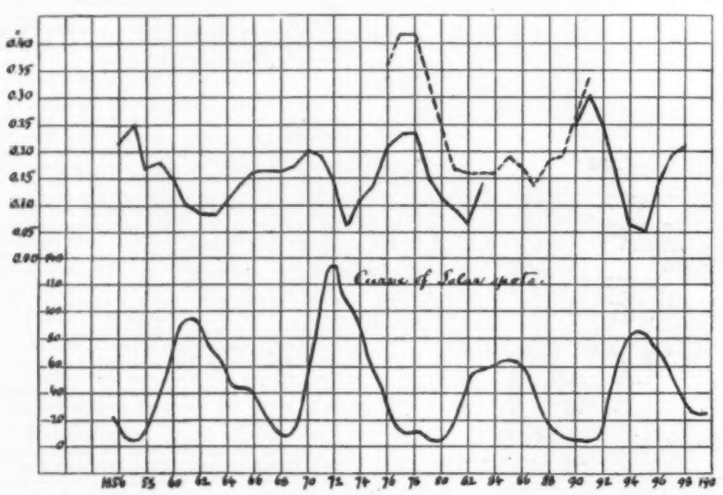


FIG. 3.—CURVES OF VARIATION OF TERRESTRIAL LATITUDE, AND OF SOLAR ACTIVITY.

The upper curves represent semi-amplitudes of latitude-variation. ——Chandler. .....Nyrén.

Journ. Nos. 277 and 446, and from Dr. Nyrén's values communicated in Publications de l'Observatoire Central Nicolas, Série ii. vol. ii.; while the second curve indicates the spot frequency according to Wolf during the same space of time. As the latitude phenomenon has been found to lag behind the spot curve by an interval of about 1·5 years, the latter curve has been shifted one and a half years in the forward direction, in effect of the new solar force from the secular variation of the obliquity, is $\varkappa = 8{\cdot}802''$, a result which is in perfect accordance with Newcomb's value obtained from other sources. The great difficulty, by which this distinguished man of science found himself embarrassed in this part of his work (see pp. 158–159 of the treatise quoted before), so much so, indeed that he well nigh despaired of arriving at a final conclusion as to the value of $\varkappa$ to be adopted, has now disappeared. The values for the masses of the earth, $m(\delta+\zeta) = 1 : 327923$, as well as of Venus, $m(\varphi) = 1 : 414991$, as derived from the secular variations, may thus be accepted with confidence.* This is one example showing the theoretical importance of the phenomena here discussed; possibly the results arrived at may be eventually found to contribute toward removing other difficulties still connected with the theory of planetary motions.

We are, it seems to me, fairly warranted in assuming the force acting in such a peculiar way on the motion of the terrestrial pole to be identical with that which exerts its influence on the secular variations. As regards the nature and origin of this force, there is a wide field for speculation. A suggestion to which I was led by a discussion on this subject with my colleague, Mr. G. Clark, of this observatory, and which seems worthy perhaps of further investigation, is that the force may stand in some connection with the still very mysterious phenomena of the earth's magnetism. There is certainly one fact which lends some support to this hypothesis, viz., the eccentric position of the earth's magnetic poles. Joule's well known experiments on magnetic strain in iron bars suggest the idea that something similar to the molecular displacement in the iron bar may take place in the body of the earth with regard to its magnetic axis. Such a strain along the axis of maximum magnetic moment would almost necessarily cause a displacement of the axis of figure with regard to the axis of rotation. Only so long as the total magnetic potential of the earth was not subject to alterations could this displacement remain constant. In that case the pole of rotation would describe a circle with a constant radius round the pole of figure. But there are facts which force us to assume that the potency of the earth's magnetic forces varies with the state of solar activity, and that consequently the molecular displacement in the direction of the magnetic axis varies accordingly. The most striking fact in this respect is the increase of auroræ with an increasing number of solar spots. Now, if we were to consider auroræ as discharges of electric force gradually accumulated in the earth's interior, the strain in the directions of the magnetic axis should have abated after such a discharge, and the pole of figure should therefore approach the pole of instantaneous rotation. This, then, would explain the fact that the semi-amplitude of latitude variation is smallest after a maximum display of solar spots. How far this hypothesis is able to account for other phenomena brought out by observation must be left to future research.—J. Halm, in Nature.

THE GERMAN ANTARCTIC EXPEDITION.†

THE German Antarctic Expedition will leave Europe, in a single ship, in the autumn of 1901. The simultaneous dispatch of a second ship is not proposed, as this does not appear to be necessary, either for the solution of the scientific problems or for the safety of the expedition. A second vessel would be expedient only if it were intended to carry out oceanographical researches around the Antarctic area at the same time as a southward advance is made by the first ship. This is rendered the less necessary, on account of the work which has been done by the German Deep Sea Expedition in Antarctic waters south of the Indian Ocean, the side on which the German Expedition will endeavor to penetrate the ice.

The designs for the Antarctic ship have been completed with the advice of the Construction Department of the Imperial Navy. The building of the ship has been undertaken by the Howaldt works in Kiel, which, in response to the circular inviting estimates, worked out an admirable plan. In designing the vessel special attention has been paid to seaworthiness, on account of the severe storms and high seas which prevail in the Southern Ocean; and, of course, she will be made as strong for ice-navigation as it is possible to build her. The necessary strength will be secured by a system of internal supports and a triple planking of oak, pitchpine and green-heart. The hull will not be so much rounded as in the case of the "Fram," such a cross-section appearing unsuitable for a ship which will have to encounter heavy seas, and the necessary resistance to ice pressure may be obtained with a somewhat fuller form. It need not be said that the vessel will be built entirely of wood. She will be rigged as a three-masted top-sail schooner, and will be provided with an engine and two boilers of power sufficient to ensure a speed of seven knots and more if necessary.

The dimensions of the ship have been decided upon after taking account of the number of the scientific staff, officers and crew who will be carried, as well as the time which the expedition is expected to be absent. The scientific staff will be five in number, and there will be five officers, including the first engineer, and eighteen to twenty men. The expedition is expected to be absent for two years, but it will be equipped for three in case it should be found necessary to prolong it. These requirements demand a length of 151 feet, and a depth of about 16 feet below the waterline. The cost of building the ship will be about £30,000.

The scientific staff of five, including the doctor, will be so chosen that each important branch of science will be represented. Each member of the staff will be able himself to carry out all the work of this own department; but every one will be capable of assisting in the special work of any other, or if necessary of taking his place. The author of this article, who has been appointed leader of the expedition, will undertake the physico-geographical, oceanographical and geodetic work; Dr. E. Philippi, of Breslau, will take charge of the geological, palæontological and chemical investigations; Dr. E. Vanhöffen, of Kiel, will act as zoologist and botanist; Dr. H. Gazert, of Munich, will be the surgeon; and the fifth member of the staff, who will have charge of the magnetic and meteorological observations, is not yet selected.

The five officers, including the captain and the first engineer, will be fully occupied with their duties in the management and navigation of the ship during the voyage. But during the year to be passed at the scientific station which will be founded by the expedition, and near which the ship will remain, the officers

* This value of the mass of Venus is in close accordance with that derived by Prof. Backlund from the perturbations of Venus on Encke's comet.

† Translated from Prof. von Drygalski's MS. by Dr. H. R. Mill.

will take such part in the scientific work as may be decided at the place and time by the leader of the expedition. They will probably be occupied principally with astronomical observations at the station, topographical and hydrographical surveys in its neighborhood, and with pendulum and magnetic on the land-journeys and at the station. The crew also, the amount of whose assistance to the scientific staff during the voyage must be regulated by their duties on the vessel, will be allocated, at the winter quarters, to the different members of the scientific staff for training, so that they will become able to lend a hand on occasion. The captain, officers and crew have not yet been appointed.

As indicated above, the work of the expedition may be divided into two parts; one carried out on board during the voyage, the other on shore at the winter quarters. The projected route of the expedition is of importance with regard to the first part. It is intended to enter the Antarctic from the direction of Kerguelen, and the details of the route, particularly the deviations from a straight course, are planned with regard to oceanographical, geological and magnetic requirements. The oceanographical considerations are the existing lacunæ in our knowledge of the depths of the sea; the geological are the collections from various island groups of specimens for comparison with those obtained in the Antarctic; the magnetic conditions make it desirable to cut the lines of equal value of the various magnetic elements in as many points as possible. Taking all these conditions into account, I propose not to run directly south from Kerguelen, but first to sail eastward to about 90° E., and then turn toward the south, as on that meridian deep-sea soundings are wanting. For the same reason the route from Cape Town to Kerguelen would be curved southward between Prince Edward and Crozet Islands, while, on the other hand, on the return voyage, the line between South Georgia and Tristan da Cunha will be straight, because it is desirable to investigate the southern extension of the great Atlantic rise.

The point which the German Expedition has in view for commencing the penetration of the Antarctic region is the still hypothetical Termination Island. The British Expedition being intended to follow the northern side of Wilkes Land, the east coast of Victoria Land, the great ice wall, and beyond that to investigate the Pacific side of the Antarctic, the German Expedition is planned to strike southward from Termination Island in order to discover the western side of Victoria Land, and to clear up its possible connection with Kemp Land and Enderby Land, and ultimately to sail round the Atlantic side of the Antarctic and investigate, wherever it may be possible, the southern extension of the Atlantic Ocean and Weddell Sea. If the two expeditions carry out this common plan, the geographical division of the work gives the best basis for co-operation in all other questions.

The second part of the German programme is the establishment of a scientific station in the Antarctic, at which a full year will be spent in geographical and biological work, and which will serve as a starting-point for longer or shorter land-journeys. It is, of course, impossible to say where this station will be, as the site must depend on the results of the discoveries made in pushing southward. An effort will be made to establish it on the west side of Victoria Land, where one may expect to find an extensive land surface which will offer a favorable opportunity for carrying on the various researches; such a position would be particularly desirable for magnetic observations, on account of its proximity to the south magnetic pole.

The great Antarctic ice-cap could probably be best reached and explored on an extensive land which might perhaps enable one to travel toward the South Pole itself. An extensive land also offers richer opportunities for the study of plant and animal life, if such exist, and also for geological phenomena, than separate islands; and observations on gravity also are of more value on a large land surface. Briefly, an effort must be made to build the German station on the coast of an extensive land, and for this purpose the west coast of Victoria Land appears the most suitable, as it is the intention of the British Expedition to land some of their party on the eastern coast, and this proximity will afford an opportunity for effective co-operation.

I can naturally only refer briefly to the particulars of the projected expedition, the main plan of which has been sketched above. The fundamental fact is that the scientific preparation will be so complete that every kind of work can be carried out which the present condition of science requires, and for which time and opportunity offer. What will actually be done must naturally be decided on the spot. The members of the expedition must be so prepared that they can distinguish the important from the less important, the necessary from the merely desirable; in a word the purely Antarctic, if one may so say, from what could be carried out equally well in other parts of the world. The desiderata of Antarctic exploration are innumerable. It is essential to make a proper choice, and this is the first object to be served by thorough preparation.

For this purpose general instructions likely to be of service will naturally be subject to the initiative of the investigators themselves when they arrive at the field of work.

I shall here only mention a few of the problems which will occupy the attention of the German Expedition. Among these, geographical studies will take the first place, since they supply the necessary foundation for all other investigations. An effort will be made, not only to lay down the coast-lines, but in some places at least, to follow out the general contour and, wherever it is possible, to study the forms of the land. The ice which gives its special character to the Polar regions will be studied as regards its nature and structure, and its temperature, its transport of land-waste, and its movement, and this should permit conclusions to be drawn as to the land which it covers. With regard to the sea, soundings will be made in the regions where they are still wanting along the intended route—that is, in the whole area south of 40° S. and in some places also to the north of that parallel. It has already been pointed out that the route has been chosen with special regard to the regions where soundings are most required. Of course, observations will be made at the same time on the physical conditions of the sea with regard to temperature, density, composition of the water and the deposits, color, dissolved gases, and circulation. It would be of great value also if pendulum observations could be carried out during the voyage, as it is intended to make this a special feature of the work on shore, and particularly in the neighborhood of the station.

The geologist's duties will include the study of the samples of deep-sea deposits brought up by the sounding-rod, and also the chemical investigation of the sea-water, the physical properties of which will be studied by the geographer. The geologist will, of course, be busily employed at every landing. He will take part in sledge journeys from the land station, along the coast, and occasionally toward the interior. Special attention will be devoted to fossil plants, if such should be found to exist in the far south, as well as to all other palæontological and petrographical questions which are likely to allow comparisons to be made between the South Polar region and the rest of the world.

The expedition promises a particularly wide field of work to the zoologist and botanist. His prospective collections should include every form which can be preserved or carried on board the ship, and they will apply equally to the fauna and flora of the land, of freshwater lakes, of the littoral zone and of the deep sea. Special attention will be paid to the seasonal differences in the occurrence of the various animal forms, and to their development. Biological investigations will, of course, be carried out in close relation to the physical; in order, for example, to recognize the dependence of plant and animal life on the conditions of the sea-water and the nature of the currents. For this purpose vertical and closing tow-nets have been planned to be used in the different regions, and from the station at different seasons. By comparing the results and those of surface gatherings at the various seasons, data will be obtained for the study of ocean currents. As the expedition is not primarily intended for deep-sea investigation, it is not proposed to carry on deep-sea observations to a depth greater than 1,000 meters. The gear required for dredging at greater depths would be too cumbrous an addition to the necessary equipment of the ship. This limitation is the less serious since the deep-sea fauna in warmer regions reaches up to within 700 meters of the surface, and in cold regions still higher.

The surgeon of the expedition will, in addition to the treatment of such illness as may arise, endeavor to collect information on Polar hygiene by a careful study of the state of health of the members of the expedition. These observations should enable him to advise the leader on many questions connected with the arrangements and manner of life of the expedition. Further physiological studies will also be carried out, and the surgeon will assist the biologist in observations on the development of various organisms, and especially with bacteriological research.

The magnetic and meteorological work of the expedition, like that of the other departments, will be the sole charge of one member of the staff, but he will be assisted in reading the instruments and in other mechanical work by members of the ship's company, and the officers will co-operate in the various physical observations at the station.

Regular meteorological observations will be taken during the voyage every four hours, if possible, and at the station three times daily. For wind, cloud, and similar phenomena, it will be desirable to organize a system of continual observation of the sky. Self-recording apparatus will be employed for pressure, wind, temperature, humidity and duration of sunshine, and in case these should become ineffective through extreme cold their place will be taken by as many eye-observations as can be managed. Special observations during the cruise will be required for such questions as the time of the daily maxima at sea, the best arrangement for a rain-gage on board, twilight phenomena in the open sea, water-spouts, etc. At the station it is intended to carry out observations on the upper regions of the atmosphere, but to what extent and in what manner cannot be decided until the balloon equipment is definitely arranged. A captive balloon will certainly be carried for the purpose of geographical reconnaissance; sufficient gas to fill the balloon about ten times, and a lifting power which will make it possible to raise an observer about 500 meters, seem to be all that is necessary. It appears to be better to carry the hydrogen for filling the balloon in compressed form rather than to prepare it on the spot, that is, if compressed gas can be carried safely on board, a point on which further information is necessary.

The programme for magnetic work is not yet definitely settled. Pending the result of further consideration and advice, the following may be looked upon as likely to form part of it. During the voyage the magnetic elements will be determined at least once a day with the standard compass, the Fox apparatus (dip-circle), and perhaps also with the deviation magnetometer. The magnetic apparatus will be installed upon the navigating bridge of the ship, in the neighborhood of which no iron will be used in the construction. At the station variation observations will be made with photographic registering apparatus, controlled by direct readings. Magnetic observations will also be provided for on the land journeys.

Particular attention will be paid to the study of the Aurora Australis, especially with regard to its form and height, perhaps also as to its spectrum, and the coincidence of auroral displays and magnetic disturbances; but the measurement of earth-currents is considered as beyond the scope of the Expedition.

In connection with the arrangements for magnetic work at the station there will be provision made for seismological observations.

Astronomical determinations of latitude and longitude, and geodetic measurements, will of course be carried out. During the voyage, and on land-journeys, the former will be fixed by means of the prismatic reflecting circle; but at the station, where a more exact astronomical determination is necessary, a large transit theodolite, and a good telescope for occultations, will be employed. At the points on the shore connected with the station a smaller universal instrument, or a prismatic circle, will be utilized. Continued time determinations will naturally be carried out in connection with absolute observations for latitude and time conversions; pendulum observations will be made as often as possible. Geographical surveys on the scale of about 1:50,000 will be desirable in the neighborhood of the station, and in such other places as may be interesting from a cartographical point of view, or which present important physical phenomena, such as ice-movement or ice-structure, or where the pendulum observations make a special survey desirable. For this purpose the smaller or even the larger universal instrument will be employed, as well as a Stampfer's level with staves. Opportunities may also occur for the use of photographic surveying instruments. Attention will be given to the anomalous refraction, which, from the observations of previous Polar travelers, appears to be due to some atmospheric conditions different from any that occur in our latitudes.

This sketch of the German programme naturally does not exhaust the problems with which we have to deal. It was, however, less my intention to give an account of the work which we hope to attempt than to indicate the directions and lay down the limits of our proposed operations, as that will be of service in finally settling the methods of international co-operation. From this point of view, the large number of the problems mentioned does not appear dangerous. It might, however, become so if the expedition were tied down to definite instructions, and not left free to act as time and opportunity demand. It seems the wisest course to provide a complete equipment for all branches of scientific work, opportunities for doing which may offer themselves, and leave it to the leader of the expedition to decide on the spot and at the time what work will be done.

I have already pointed out that the basis of international co-operation has been laid in the choice of routes and the consequent division of districts within which the land stations are to be established. The German Expedition takes the Indian Ocean and Atlantic side, and the British the Pacific side of the Antarctic area. An expedition from a third side would find a wide and important field of activity to the south of South America. As regards physico-geographical, geological, biological and gravity observations, scarcely any further co-operation is required than the simultaneous carrying out of observations in the different areas. Should the British Expedition include a second ship, it would be possible to carry on biological deep-sea research round the Antarctic area over a much wider circle than we can attempt with one vessel.

A clearer understanding is still required, in my opinion, for co-operation in meteorological and magnetic research, to decide, in the first place, the scope and the methods of research to be pursued during the voyage and during the year's sojourn at the land station; and in the second place, what additional work beyond that undertaken by the two expeditions it may be possible to arrange. My scheme for the first of these plans is already sketched out as far as regards the meteorological work; the magnetic programme requires still further consideration. The understanding with the British Expedition on this question is now under discussion. For both branches of science the choice of routes and of districts in which the stations will be placed is very appropriate, as observations will be made in the vicinity of the south magnetic pole on two sides, and both stations lie in the probable position of the Antarctic anti-cyclone, which appears to extend furthest north on the Indian Ocean side. The second point, which concerns the organization of simultaneous observations outside the Antarctic area, is still unsettled. The British Antarctic Expedition has already in view the establishment of a scientific station in New Zealand, while Germany is planning a branch station on Kerguelen. These would furnish valuable data for comparison with the results obtained by the expeditions themselves. Yet, we must go further, but not so far, I think, as M. Arçtowski suggested in his paper to the British Association at Dover. It is greatly to be wished that during our expeditions the observatories of Melbourne and Cape Town would undertake similar observations, and it would also be a good thing if a station could be placed near Cape Horn or in South Georgia, as well as one in the North Polar region, say at Bossekop. Thus the problems of the Antarctic regions could be attacked simultaneously from without and from within.

A resolution of the St. Petersburg Meteorological Congress, in August last, in favor of such co-operation was received with pleasure. The International Geographical Congress at Berlin went further, and unanimously approved the appointment of a committee charged with (1) Laying down the scope and the means of investigation for the magnetic and meteorological work of the expeditions; (2) the organization of similar series of observations on the expeditions, and perhaps also exerting influence for the establishment of observations at other places.

On the German side, the members of this joint committee are Profs. Hellmann, v. Drygalski, Eschenhagen and A. Schmidt; and on the British side, Dr. R. H. Scott, Dr. Buchan, Prof. Schuster and Capt. Creak. The programme prepared on the German side for the meteorological and magnetic work has already been sent to the British members of the Committee to be considered by them, and afterward discussed and definitely settled by the whole committee. We may expect in this, as in all other points, a complete and useful co-operation between the two expeditions.

ERICH VON DRYGALSKI.

The report of W. F. T. McHarg, an assistant conservator of forests in the Upper Burma, states that the rubber from the west of the Mindu hills comes from the Ficus elastica and not from a creeper as was generally supposed, says The India Rubber World. The most interesting point in this discovery is that heretofore it was not believed that this tree flourished in such low latitudes, though the major part of the Burmese rubber output has always been known to be the product of the Ficus trees. As a matter of fact, exploration does not point to any great increase in the output of rubber from the Mindu district, but the news is of extreme interest from a botanical standpoint. The report of the valuation survey throughout that country, as published in The Indian Forester, is of great interest, especially the portions that treat upon the chats with the heads of different villages who are but just learning that rubber is valuable but do not know how to gather it. Those who have learned the work, however, are intelligent

enough to appreciate that the trees must be allowed rest between the tappings, and that the incision must be such that the wound may heal easily. The trees are all tapped in cold weather, as then the yield is best. There are only a few men in a village who are expert enough to do the work, as it necessitates a great deal of climbing. They tap not only the aerial roots, but the large branches; indeed, anything that is large enough to bear a cut.

ROADSIDE FRUIT TREES.

IT is well known that it has long been the custom in France to plant by the roadside various kinds of forest trees, chiefly the poplar, the ash, and the elm. In the case of the national highways these trees are the property of the State, and when they have reached a certain age—generally about sixty years—they are cut down and sold for timber. In summer the shade afforded by the overhanging foliage is a great boon to soldiers on the march and other pedestrians. Even the shade of the poplar, meager as it is, is better than the white glare of the dusty road without a line of shadow to break the monotonous dazzle. This system, however, of roadside planting is undergoing a change. In several departments fruit trees are taking the place of forest trees, and if the experiment proves satisfactory, the French government will in course of time become growers of fruit on a very extensive scale.

The example of Germany, which has made itself felt so much in France in ways absolutely at variance with husbandry, has also given the impulse which has resulted in this roadside fruit culture.

In Alsace-Lorraine the wayside orchards now produce an annual revenue of 150,000 francs. Switzerland, Belgium, and Luxemburg have already imitated Germany in this matter with marked success, and if the system does not produce equally good results in France—a country so highly favored as regards climate—the explanation must be looked for in bad management. The fruit trees that can be most successfully cultivated by the side of roads are the cherry, the apple, the pear, and the plum. In a great deal of the central and southern part of France the climate is perfectly suited to the peach, the apricot, the quince, and the walnut. This last already borders the French roads over a vast extent of country, but the trees are planted in the fields, and even the nuts that drop upon the public way are regarded as the property of the landowners. From an English point of view it seems very unsafe to plant fruit trees where all who pass along a high road may help themselves to the fruit, but where there is plenty there is small risk of theft. In Alsace-Lorraine the wayside fruit trees are farmed out by the State. Under no other system could the French government with its complicated administrative machinery make fruit growing profitable.—Leisure Hour.

Import of Plants and Fruits into Cape Colony.—Consul-General Stowe sends from Cape Town, February 7, 1900, copy of the regulation affecting the importation of fruits and plants. A summary is given below:

"The importation into the colony of grape vines or portions thereof is prohibited, except those imported by the government with such precautionary measures as it may deem necessary.

"All trees and plants, other than vines, and parts thereof, and all fruits of any description, and all tubers, roots, bulbs, or portions thereof, and packages, etc., containing the same, shall undergo strict examination by an officer to determine the absence of noxious insects and plant diseases; and the consignee must open packages, etc., to permit the examination to be made. Without a certificate from the officer showing the absence of insects or diseases, no articles such as those named can be entered. If insects or diseases are found, the consignee must cleanse or disinfect the plants or coverings as prescribed by the officer.

"The importation of any stone-fruit tree, or any fruit, graft, cutting, scion, root, or seed, growth or produce thereof, from the United States or Canada is prohibited.

"These regulations do not apply to canned or preserved fruits."

Mr. Stowe adds that a proposal is now under consideration to relax this prohibition in so far as regards any part of the United States where the diseases "peach yellows" or "peach rosette" do not exist.

Machinery Exhibition at Christiania.—Consul Bordewich sends from Christiania, February 16, 1900, programme of the permanent machinery exhibition which has been opened in that city. Manufacturers, agents, and other interested parties are invited to exhibit. The metal, wood-working, spinning, and weaving industries will be represented, as well as works in paper, leather, rubber clothing, etc.; also engines. The programme sets forth that machinery, tools, etc., can be exhibited at a low rent in centrally situated rooms. Appliances can be shown in operation without extra expense for driving power. New and patented machinery and appliances may be exhibited and advertised cheaply and effectively. Catalogues of the exhibition will be distributed without extra expense to the exhibitors.

Mr. Bordewich advises that new inventions should be patented in that country before they are shown. Applications for patent in Norway should be made within six months after patent is granted in the United States. Import dues are light. Goods should be sent knocked down, if possible, to save freight. For information, address the Clfheim Company, St. Olafs gade, 22, Christiania.

Ownership of Railroads in Nicaragua.—Under date of February 7, 1900, Consul Donaldson writes from Managua to a New York firm:

All the railroads of Nicaragua belong to the government, and are directly under the charge of the Minister of Fomento, Hon. S. Ramirez. He also has charge of all the steamboats except one line, which is managed by E. Nicol, agent, Greytown, Nicaragua. There are also two tramways managed by F. H. Davis, Rivas, Nicaragua, and the Granada Tramway Company, Granada, Nicaragua.

NEW BOOKS

Accumulators. How Made and Used. An Elementary Handbook for the use of Amateurs and Students. Edited by Percival Marshall. 12mo, cloth, 80 pages, 40 illustrations. New York, 1899.....$0 50

Agriculture. Principles of Agriculture. A Textbook for Schools and Rural Societies. By L. H. Bailey. 16mo, cloth, 300 pages, illustrated. New York, 1899.....$1 25

Air-Brake Catechism. For Firemen, Engineers, Air-brake Instructors, Shop Men, and all branches of Railroad Men. By Robert H. Blackall. 12mo, cloth, 240 pages, illustrated. New York, 1899 . .$1 50

Alaska and the Klondike. A Journey to the New Eldorado, with Hints to the Traveler and Observations on the Physical History and Geology of the Gold Regions, the Conditions of and Methods of Working the Klondike Placers, and the Laws Governing and Regulating Mining in the Northwest Territory of Canada. By Angelo Heilprin. Fully illustrated from photographs and with a map of the gold regions. 12mo, cloth, 315 pages. New York, 1899.....$1 75

Astronomy. The Elements of Practical Astronomy. By W. W. Campbell. Second edition revised and enlarged, 8vo, cloth, 261 pages. New York, 1899.....$2 25

Birds. A Dictionary of Birds. By Alfred Newton, assisted by Hans Gadow, with contributions from Richard Lydecker, Charles S. Roy, and Robert W. Shufeldt. 8vo, cloth, illustrated, 1,088 pages. London.....$5 00

Birds. The First Book of Birds. By Mrs. Harriet Mann Miller. With 8 colored and 12 plain plates, and 20 figures in the text. 12mo, cloth, 149 pages. Boston, 1899.....$1 00

Botany for Beginners. By Ernest Evans. 16mo, cloth, 250 pages. New York, 1899.....$0 75

Building Construction and Superintendence. By F. E. Kidder. Part II., Carpenter's Work. Second edition, 8vo, cloth, 544 pages, 384 illustrations. New York, 1899.....$4 00

Cement. Portland Cement. Its Manufacture, Testing and Use. By D. B. Butler. 8vo, cloth, 360 pages, 85 illustrations. London, 1899..$6 00

Chemistry. The Arithmetic of Chemistry. Being a simple treatment of the subject of Chemical Calculations. By J. Waddell. 12mo, cloth, 138 pages. New York, 1899.....$1 00

Chemistry. Descriptive General Chemistry. A Textbook for Short Course. By S. E. Tillman. 8vo, cloth, 429 pages. New York, 1899.....$3 00

Clay Modelling for Schools. A Progressive Course for Primary Schools and Grammar Grades. By Anna M. Holland. 8vo, cloth, illustrated, 21 pages, 19 plates. Boston, 1899.....$1 00

Cyanide Process. Practical Notes on the Cyanide Process. By F. L. Bosqui. 8vo, cloth, illustrated, 201 pages. New York, 1899. $2 50

Decorative Designs of all Ages, for all Purposes. With numerous engravings and diagrams. Edited by Paul N. Hasluck. 16mo, cloth, 160 pages. London, 1899.....$0 50

Dams. The Design and Construction of Dams, including Masonry, Earth, Rock-Fill, and Timber Structures. Also the principal types of Movable Dams. By Edward Wegmann. Fourth edition, revised and enlarged. Quarto, cloth, 250 pages of text, 88 folding plates. New York, 1899.....$5 00

Electrotyping. A Practical Treatise on the Art of Electrotyping by the latest known methods. Containing historical review of the tools and machinery required, and complete instructions for operating an Electrotyping plant. By C. S. Partridge. 12mo, cloth, 140 pages, illustrated. Chicago, 1899.....$1 50

Engineer's Handy-Book. Containing Facts, Formulæ, Tables and Questions on Power, Its Generation, Transmission and Measurement, Heat, Fuel and Steam, the Steam Boiler and accessories, Steam Engines and their parts, the Steam Engine Indicator, Gas and Gasoline Engines, etc., etc. etc. By Stephen Roper. Fifteenth edition, revised and greatly enlarged by E. R. Keller and Clayton W. Pike. 12mo, 844 pages, leather pocketbook form. Philadelphia, 1899.....$3 50

Modern Mechanism. A Resume of Recent Progress in Mechanical, Physical, and Engineering Science. By Charles H. Cochrane. New and enlarged edition. Illustrated. 12mo, cloth. Philadelphia, 1899.$1 50

Naval Architecture. A Textbook of Theoretical Naval Architecture. By E. L. Atwood. 12mo, cloth. 395 pages. Illustrated. London and New York, 1899.....$2 50

Optics. A Treatise on Photographic Optics. By S. R. Cole. 8vo, cloth, illustrated, 350 pages. New York, 1899.....$2 50

Photography. Amateur Photography. A Practical Guide for the Beginner. By W. I. Lincoln Adams. 12mo, cloth, 135 pages, illustrated. New York, 1899.....$1 25

Picture Framing. Mounting and Framing Pictures. With 240 engravings and diagrams. Edited by Paul N. Hasluck. 16mo, cloth, 160 pages. London and New York, 1899.....$0 50

Plants. A Textbook of Plant Diseases Caused by Cryptogamic Parasites. By George Massee. 12mo, cloth, 458 pages, fully illustrated. London, 1899.....$1 75

Plant Relations. A First Book of Botany. By John M. Coulter, 12mo, cloth. New York, 1899.....$1 25

Prospecting, Locating, and Valuing Mines. By R. H. Stretch. 12mo, cloth, 374 pages. New York, 1899.....$2 00

Railways. Light Railways at Home and Abroad. By Wm. H. Cole. With plates and illustrations. 8vo, cloth. Philadelphia, 1899.....$5 00

Refrigeration. Compend of Mechanical Refrigeration. A Comprehensive Digest of Applied Energetics and Thermodynamics for the Practical Use of Ice Manufacturers, Cold Storage Men, Contractors, Engineers, Brewers, Packers, and others interested in the application of Refrigeration. Third edition. By J. E. Siebel. 12mo, cloth. 268 pages. Chicago, 1899.....$3 00

Science. Early Chapters in Science. A first book of knowledge of Natural History, Botany, Physics, and Chemistry for Young People. By Mrs. W. Awdry. Edited by W. F. Barrett. 12mo, cloth. 348 pages. New York, 1899.....$3 00

Science. The Fairy Land of Science. By Arabella B. Buckley. New and revised edition. 12mo, cloth. Illustrated. New York, 1899...$1 50

Sewer Design. A course of Lectures delivered at Cornell University, intended for those Students whose intentions to enter the field of Sanitary Engineering calls for more special and detailed work than is required of all Civil Engineering Students. By H. N. Ogden. Illustrated, and 5 folding plates. 12mo, cloth. New York. 1899.....$2 00

Slide Valve. The Slide Valve Simply Explained. By W. J. Tennant. Revised and much enlarged by J. H. Kinealy. Fully illustrated with original drawings and diagrams. 16mo, cloth. 83 pages. New York, 1899.....$1 00

Smith's Work. With 211 engravings and diagrams. Edited by Paul N. Hasluck. 16mo, cloth, 160 pages. London and New York, 1899.....$0 50

Soap Bubbles. Fun with Soap Bubbles, including Book and Complete Outfit for Fancy Bubbles and Films. For the Amusement of Young and Old. By Thomas N. St. John. 16mo, paper cover.....$0 35

Stable. The Private Stable. Its Establishment, Management, and Appointments. By "Jorrocks." With full page plates. Small quarto, cloth. 652 pages. Boston, 1899.....$3 00

Steam Boiler Practice in its Relation to Fuels and their Combustion, and the Economic Results Obtained with Various Methods and Devices. By Walter B. Snow. 8vo, cloth. 297 pages. New York, 1899. $3 00

Steam Engine. The Steam Engine and Gas and Oil Engines. A book for the use of students who have time to make experiments and calculations. By J. Perry. 8vo, cloth. 646 pages. Illustrated. New York, 1899.....$3 25

Technological Dictionary. By N. Ponce de Leon. English-Spanish and Spanish-English of Words and Terms employed in the Applied Sciences, Industrial Arts, Fine Arts, Mechanics, Machinery, Mines, Metallurgy, Agriculture, Commerce, Navigation, Manufactures, Architecture, Civil and Military Engineering, Marine, Military Art, Railroads, Telegraphs, etc., etc. Vol. I., Ingles-Espanol. 8vo, half leather. 873 pages, $8.50. Vol. II., Spanish-English. 8vo, half leather. 782 pages, $7.50. Complete in 2 volumes.....$16 00

Testing Materials. Handbook of Testing Materials for the Constructor. Part I., Methods, Machines, and Auxiliary Apparatus. (In two volumes: Vol. I., Text; Vol. II., Illustrations.) By Prof. Adolf Martens. Authorized translation and addition, by Gus. C. Henning. 8vo, cloth, 2 vols., 622 pages, 1,090 figures. New York, 1899.....$7 50

Volcanoes. Their Structure and Significance. By T. G. Bonney. 12mo, cloth. 317 pages. Illustrated. New York, 1899.....$2 00

Water Supply. The Elements of Water Supply Engineering. By E. Sherman Gould. 8vo, cloth. Illustrated. New York, 1899.....$2 00

Wiring. The Internal Wiring of Buildings. By H. M. Leaf. With many illustrations and diagrams. 12mo, cloth. 198 pages. London, 1899.....$1 50

MUNN & CO., Publishers,
SCIENTIFIC AMERICAN OFFICE,
361 Broadway, New York.

THE Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers, 361 Broadway, New York.

TABLE OF CONTENTS.

PAGE

I. ASTRONOMY.—The Relation Between the Periodic Changes of Solar Activity and the Earth's Motion.—3 illustrations..... 20315

II. BUILDING.—New Fireproof Material in Germany..... 20314

III. COMMERCE.—Trade Suggestions from United States Consuls.. 20312

IV. ECONOMICS.—The Future Wheat Problem..... 20304

V. ELECTRICITY.—The Facilities Afforded by the Office of Standard Weights and Measures for the Verification of Electrical Standards and Electrical Measuring Apparatus..... 20304

VI. ETHNOLOGY.—Art and Fashion Among the Pahouins.—10 illustrations..... 20310

VII. FERTILIZER.—Chemical Manures Applied to Fruit Trees..... 20314

VIII.—FORESTRY.—Forest Conditions in the Klondike..... 20311

IX. HYGIENE.—The Poison in Our Food..... 20308
Walking as a Tonic and Pastime..... 20305

X. MECHANICAL ENGINEERING.—Apparatus for Lifting Rails.—1 illustration..... 20307
Downie's Patent Piston Rings.—3 illustrations..... 20306
Machine for Operating a Pile Driver by Means of the Current of a River.—1 illustration..... 20307
Machinery—Labor-Saving, Labor-Creating or Labor-Killing?.. 20307
Six Hundred Horse Power Blast Furnace Gas Motor and Blowing Engine.—1 illustration..... 20306

XI. MISCELLANEOUS.—The Burning of the Theatre Français.—1 illustration..... 20304
Brunton Memorial Chair..... 20313
Meerschaum Pipe Centenary..... 20313
Roadside Fruit Trees..... 20318
Miscellaneous Notes..... 20313
Trade Notes and Receipts..... 20313

XII. MOTOR CARRIAGES.—The Vedovelli and Priestley Cab.—2 illustrations..... 20315

XIII. PHOTOGRAPHY.—Photographic Novelties.—2 illustrations.. 20314

XIV. PHOTOMETRY.—A Simple Illumination Photometer.—4 illustrations..... 20309

XV. TRAVEL AND EXPLORATION.—The German Antarctic Expedition..... 20315

Automobiles

The SCIENTIFIC AMERICAN for May 13, 1899, is devoted mainly to illustrations and detailed descriptions of various types of horseless vehicles. This issue also contains an article on the mechanics of the bicycle and detailed drawings of an automobile tricycle. Price 10 cents.

The following copies of the SCIENTIFIC AMERICAN SUPPLEMENT give many details of Automobiles of different types, with many illustrations of the vehicles, motors, boilers, etc. The series make a very valuable treatise on the subject. The numbers are: 732, 979, 993, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1075, 1078, 1080, 1082, 1083, 1099, 1100, 1113, 1122, 1178, 1195, 1199, 1206, 1210. SUPPLEMENT No. 1229 contains a highly interesting article giving full data as to operating costs of horse and electric delivery wagons in New York city. Price 10 cents each, by mail. For sale by all newsdealers, or address

MUNN & CO., Publishers,
361 Broadway, - - - New York City.

BUILDING EDITION
OF THE
SCIENTIFIC AMERICAN.

Those who contemplate building should not fail to subscribe.

ONLY $2.50 A YEAR.

Semi-annual bound volumes $2.00 each, yearly bound volumes $3.50 each, prepaid by mail.

Each number contains elevations and plans of a variety of country houses; also a handsome

COLORED PLATE.

SINGLE COPIES - - - - 25 CENTS EACH.

MUNN & CO., 361 Broadway, New York.

PATENTS!

MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had over *fifty years' experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Trade Marks, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.

A pamphlet sent free of charge on application, containing full information about Patents and how to procure them; directions concerning Trade Marks, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases, Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws, showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York
BRANCH OFFICES.—No. 625 F Street, Washington, D. C.